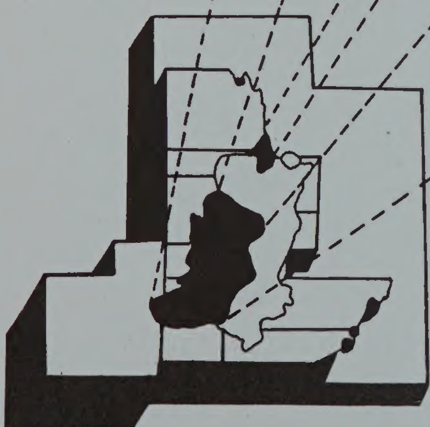
RESOURCE RELATED PROBLEMS

BEAVER RIVER BASIN

APPENDIX III Pt. 1

JUNE 1973

UTAH
NEVADA



Prepared By
UNITED STATES
DEPARTMENT of AGRICULTURE
Economic Research Service – Forest Service
Soil Conservation Service
In cooperation with
UTAH STATE
DEPARTMENT of NATURAL RESOURCES
and UNITED STATES DEPARTMENT of INTERIOR
Bureau of Land Management

USDA-SCS-PORTLAND, OREG. 1973

APPENDIX III

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BEAVER RIVER BASIN, UTAH-NEVADA

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June 1973

The following publications have been prepared under the Beaver River Basin study:

Summary Report	
Appendix I	Natural Resource Inventory Soils Supplement
Appendix II	Present and Projected Resource Use and Management Water Related Land Use Supplement Water Budget Analysis Supplement
Appendix III	Resource Related Problems
Appendix IV	Economic Base and Needs
Appendix V	Potential Development Opportunities Irrigation Systems Supplement

APPENDIX III

RESOURCE RELATED PROBLEMS

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INTRODUCTION

This appendix and others prepared during the study provide back-up data to the main report. It contains detailed information intended to supplement discussions appearing in the main report, and describes resource related problems with emphasis on those related to water. Erosion and sedimentation, flood damage, agricultural water management, land management, and environmental problems are discussed.

This appendix was one of five prepared to provide information on the basic water and land resources of the Beaver River Basin. These appendicies are listed on the back side of the cover page. Appendicies I and II describe the basic resources and present and projected resource uses. A "Soils supplement" accompanies Appendix I, while two supplements, "Water Budget Analysis:, and "Water Related Land Use Inventory", were prepared to accompany Appendix II. Data appearing in these supplements were too voluminous to be included with the other data. Appendix IV presents historical economic data and shows an interpretation of future needs. Appendix V deals with solutions and alternatives to solve the problems illustrated within this appendix.

EROSION AND SEDIMENTATION PROBLEMS

This section includes four aspects of this problem: gross erosion, stream channel erosion, sediment yield from critical areas, and sediment deposition. Gross erosion evaluates the onsite loss of soil from wind, and water action and is expressed in inches of soil lost annually. Stream channel erosion is based on the miles of perennial stream that are stable, moderately eroding, or rapidly erosion within selected watersheds. Sediment yield from critical areas is based upon hydrologic and physical characteristics of each watershed and is expressed in acre-feet annually. Damages of sedimentation to fish habitat, reservoirs, irrigation systems and other facilities are described in the sediment deposition section.

GROSS EROSION

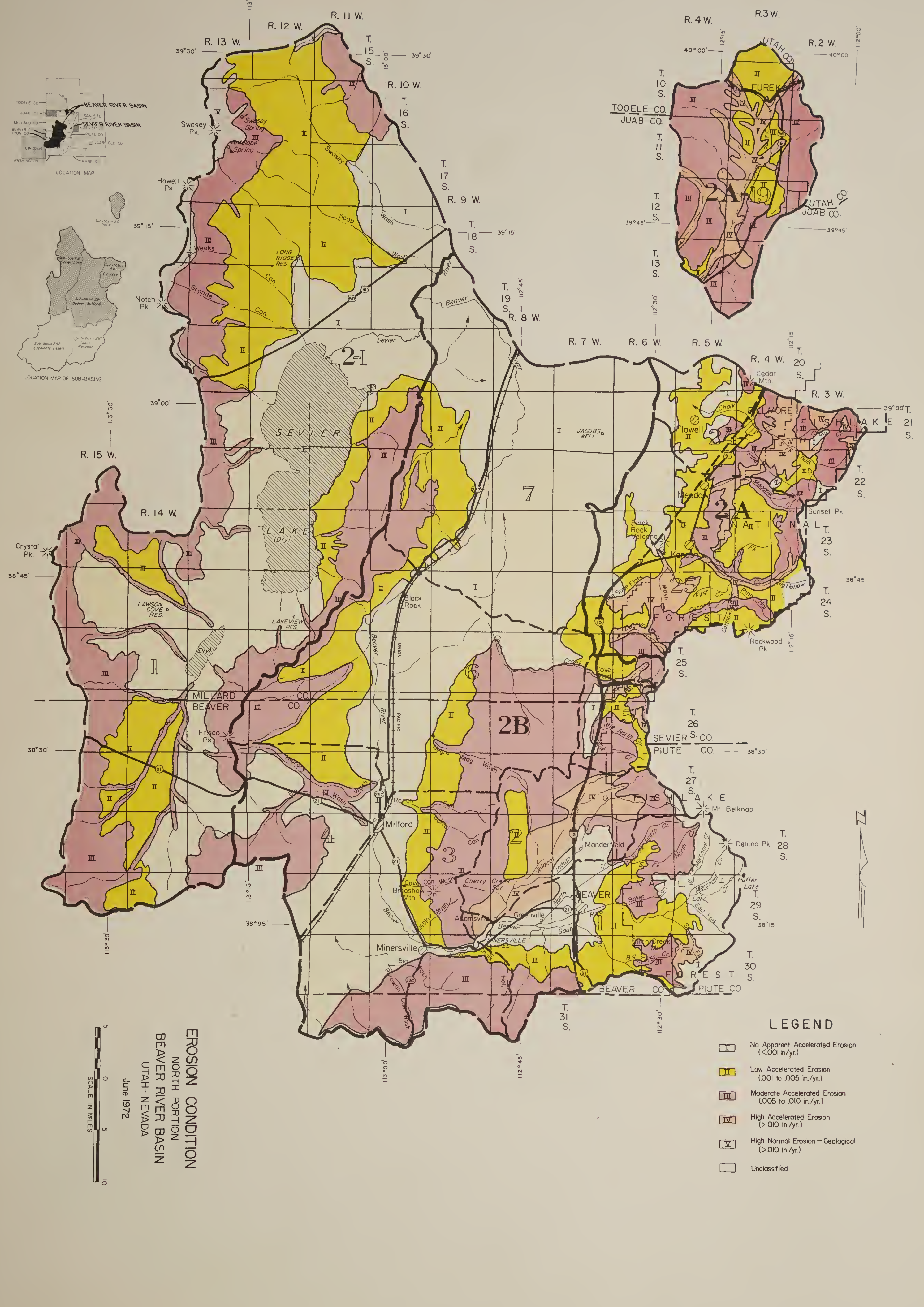
Mountains have been eroding at normal or geological rates according to the particular combination of rock, physiography, climate, soil, vegetation, and other biota, that characterize the Basin. In some areas the rate of this normal or geologic erosion is high; in other areas, rates of erosion have been accelerated by man's activities. Streams have cut down through ancient alluvial sediments that, according to some authorities[1], have been stable for ages.

In areas of low rainfall, sparse plant cover provides little soil protection, and violent thunderstorms frequently produce flash floods. A large part of the erosion in these areas is geologic or normal. In areas of higher rainfall, erosion is often the direct result of man's activity.

The Beaver River Basin was mapped and classed according to rates and types of erosion. Class V includes rates of high normal (geologic) erosion exceeding .010 inches of soil loss per year. Class IV includes rates of high accelerated erosion of more than .010 inches per year. Class III includes moderate accelerated erosion of .005-.010 inches per year. Class II includes low accelerated erosion rates of .001-.005 inches per year and Class I includes no apparent accelerated erosion or rates less than .001 inches per year.

Erosion condition classes are indicated on the map following page 2 and the acreage of each class is shown in Table 1. National Forests were mapped from data collected during the soils inventory and from range analysis data. Areas outside National Forests were mapped from information provided by Bureau of Land Management and Soil Conservation Service. Table 2 indicates the amount of soil currently being removed, as evaluated by various classes of erosion.

1"Erosion: Accelerated and Normal", A.R. Croft, Intermountain Forest and Range Experiment Station, 1949.


EROSION CONDITION
NORTH PORTION
BEAVER RIVER BASIN
UTAH-NEVADA
June 1972
SCALE IN MILES
5 0 5 10
LEGEND
I No Apparent Accelerated Erosion (<.001 in./yr.)
II Low Accelerated Erosion (.001 to .005 in./yr.)
III Moderate Accelerated Erosion (.005 to .010 in./yr.)
IV High Accelerated Erosion (>.010 in./yr.)
V High Normal Erosion—Geological (>.010 in./yr.)
Unclassified
LOCATION MAP
BEAVER RIVER BASIN
SEVIER RIVER BASIN
LOCATION MAP OF SUB-BASINS
TOOELE CO.
JUAB CO.
UTAH CO.
MILLARD CO.
BEAVER CO.
SEVIER CO.
PIUTE CO.
EUREKA
Fillmore
Flowell
Meadow
Kanosh
Milford
Minersville
Adamsville
Greenville
Manderfield
Beaver
SEVIER LAKE (Dry)
FISHLAKE NATIONAL FOREST
Swasey Pk.
Howell Pk.
Notch Pk.
Crystal Pk.
Frisco Pk.
Cedar Mtn.
Sunset Pk
Rockwood Pk
Mt Belknap
Delano Pk
Black Rock Volcano
Bradshaw Mtn
Swasey Spring
Antelope Spring
Weeks
Granite
Long Ridge Res
Lawson Cove Res.
Lakeview Res
Jacobs Well
Minersville Res
Puffer Lake
Black Rock
Union Pacific
Beaver River
Sevier River
Chalk
Cove
Cove Creek
Cherry Creek
Wildcat
Indian
North Cr
South
Baker
Merchant Cr
East Fork
Big Wash
Pine
Meadow Cr
Mag Wash
Can Wash
Hickory
Big Hollow
First Cr
Second Cr
Cottonwood
Little North Cr
Soap Wash
Swasey Wash
Con
2-1
7
2A
2A-19
2B
2
3
4
6
1
R. 15 W.
R. 14 W.
R. 13 W.
R. 12 W.
R. 11 W.
R. 10 W.
R. 9 W.
R. 8 W.
R. 7 W.
R. 6 W.
R. 5 W.
R. 4 W.
R. 3 W.
R. 2 W.
T. 10 S.
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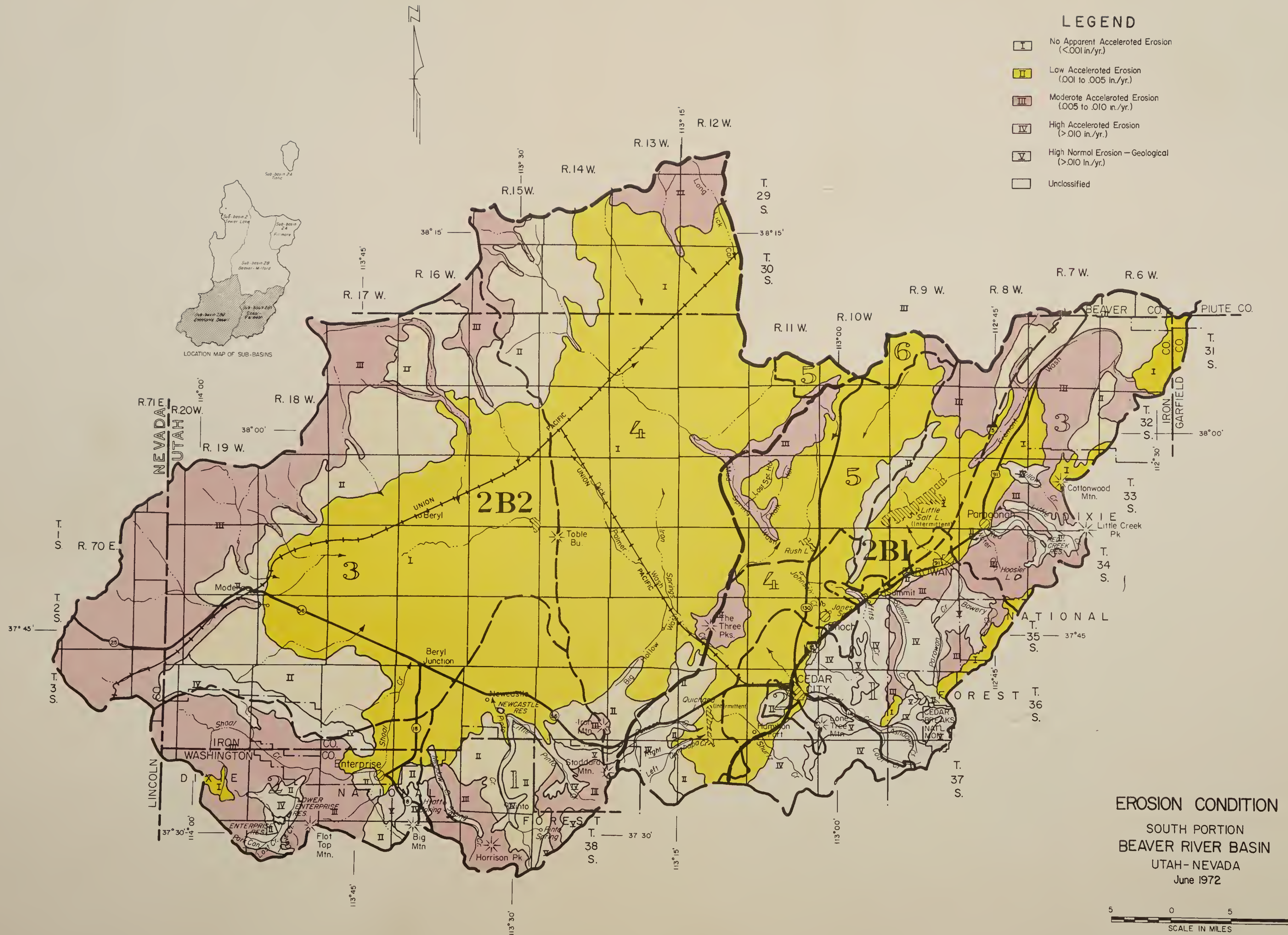
T. 28 S.
T. 29 S.
T. 30 S.
T. 31 S.
40°00'
39°45'
39°30'
39°15'
39°00'
38°45'
38°30'
38°15
112°00'
112°15'
112°30'
112°45'
113°00'
113°15'
113°30'



EROSION CONDITION

SOUTH PORTION
BEAVER RIVER BASIN
UTAH-NEVADA
June 1972

TABLE 1.--Acreage by erosion classes, Beaver River Basin, 1970

Watershed and subbasin	Class I 0"-.001"	Class II .001"-.005"	Class III .005"-.010"	Class IV .010" +	Class V .010" +
	Acres	Acres	Acres	Acres	Acres
2-1 Sevier Lake	492,460	320,680	309,220	-	22,910
2A-19 Tintic	-	37,340	92,560	32,470	-
2A-24 Chalk Cr.	24,360	37,120	38,270	16,240	-
2A-25 Corn Cr.	42,640	93,810	46,900	29,850	-
2A FILLMORE	67,000	168,270	177,730	78,560	-
2B-1 Beaver	92,430	54,620	48,320	14,710	-
2B-2 Wildcat Cr.	7,910	12,430	49,710	42,930	-
2B-3 Minersville	103,300	25,830	105,650	-	-
2B-4 Milford	68,790	12,280	41,760	-	-
2B-5 Cove Cr.	5,970	14,420	24,380	4,970	-
2B-6 Black Rock	143,380	75,100	122,900	-	-
2B-7 Jacobs Well	313,120	45,820	22,910	-	-
2B BEAVER-MILFORD	734,900	240,500	415,630	62,610	-
2B1-1 Coal Cr.	54,350	8,050	26,160	78,490	34,210
2B1-2 Greens Lake	1,810	1,810	-	1,810	810
2B1-3 Red Cr.	84,930	52,450	99,910	12,490	-
2B1-4 Quichapa Cr.	57,190	14,300	9,190	20,430	1,020
2B1-5 Rush Lake	93,360	8,710	22,410	-	-
2B1-6 Other	7,700	-	3,300	-	-
2B1 CEDAR-PAROWAN	299,340	85,320	160,970	113,220	36,040
2B2-1 Pinto Cr.	56,750	45,070	36,720	20,030	8,350
2B2-2 Shoal Cr.	18,450	15,610	87,990	17,030	2,840
2B2-3 Beryl	279,490	152,450	203,260	-	-
2B2-4 Big Hollow	382,920	65,500	50,390	5,040	-
2B2-5 Other	7,020	-	1,980	-	-
2B2 ESCALANTE DESERT	744,630	278,630	380,340	42,100	11,190
Basin total	2,338,330	1,093,400	1,443,890	296,490	70,140
Percentage of total	44.6%	20.9%	27.5%	5.7%	1.3%

TABLE 2.--Annual on-site soil loss by erosion classes, Beaver River Basin, 1970

Watershed and subbasin	Erosion condition class[a]				Normal or geologic .010 +
	Class II .0001-.005	Class III .005-.010	Class IV .010 +	Total accelerated	
	Acre-feet	Acre-feet	Acre-feet	Acre-feet	Acre-feet
2-1 Sevier Lake	66.81	193.26	-	260.07	28.64
2A-19 Tintic	7.78	57.85	40.59	106.22	-
2A-24 Chalk Cr.	7.73	23.91	20.30	51.94	-
2A-25 Corn Cr.	19.54	29.32	37.31	86.17	-
2A FILLMORE	35.05	111.08	98.20	244.33	-
2B-1 Beaver	11.38	30.20	18.39	59.97	-
2B-2 Wildcat	2.59	31.07	53.66	87.32	-
2B-3 Minersville	5,38	66.03	-	71.41	-
2B-4 Milford	2.56	26.10	-	28.66	-
2B-5 Cove Cr.	3.00	15.23	6.21	24.44	-
2B-6 Black Rock	15.64	76.82	-	92.46	-
2B-7 Jacobs Well	9.55	14.32	-	23.87	-
2B BEAVER-MILFORD	50.10	259.77	78.26	388.13	-
2B1-1 Coal Cr.	1.68	16.35	98.11	116.14	42.76
2B1-2 Greens Lake	0.37	-	2.26	2.63	1.01
2B1-3 Red Cr.	10.93	62.45	15.61	88.99	-
2B1-4 Quichapa	2.98	5.74	25.54	34.26	1.28
2B1-5 Rush Lake	1.81	14.01	-	15.82	-
2B1-6 Other	-	2.06	-	2.06	-
2B1 CEDAR-PAROWAN	17.77	100.61	141.52	259.90	45.05
2B2-1 Pinto Cr.	9.39	22.95	25.04	57.38	10.44
2B2-2 Shoal Cr.	3.25	54.99	21.29	79.53	3.55
2B2-3 Beryl	31.76	127.04	-	158.80	-
2B2-4 Big Hollow	13.65	31.49	6.30	51.44	-
2B2-5 Other	-	1.24	-	1.24	-
2B2 ESCALANTE DESERT	58.05	237.71	52.63	348.39	13.99
BASIN TOTAL	227.78	902.43	370.61	1,500.82	87.68

a Erosion Class I considered as zero soil loss.

STREAM CHANNEL EROSION

Erosion of stream channels presents some special problems. Once stream channels begin to cut through existing stable alluvium, changes in the character of the stream and adjacent vegetation rapidly occur and are difficult to reverse. Stream channels were evaluated as to their stability (Table 3).

The method[1] used evaluates each stream reach as (a) stable, (b) moderately eroding, or (c) rapidly eroding. Indicators used are:

a. Stable - (1) channel sides well vegetated; (2) no slumping of channel sides; (3) very little or no cutting or deposition of channel bottom; (4) aquatic vegetation on channel sides and bottom; (5) algae on rocks; and (6) very little or no recent cutting or deposition along channel sides. Stream channels in rock, although they sometimes exhibit some of the characteristics of eroding streams such as lack of aquatic vegetation, were classified as stable.

b. Moderately eroding - (1) channel sides partially vegetated; (2) slumping of channel sides at constrictions, bends, or steep grades, and deposition in areas where the water velocity is less; (3) aquatic vegetation scattered, mostly in areas where stream velocities are low; (4) algae on rocks in places where the bottom is stable; and (5) some cutting of stream banks at constricted areas or at outside of bends, deposition at the inside of bends and at the confluence with other streams.

c. Rapidly eroding - (1) very little vegetation on channel sides; (2) slumping of channel sides common; (3) cutting and deposition of channel bottom common, bottom obviously in a state of flux; (4) no aquatic vegetation; (5) large scale cutting of stream banks is common.

A stream channel conditions inventory was completed during the summer of 1968. Stream reaches evaluated primarily extended from the headwaters to the first irrigation diversion near the canyon mouths. Most of the distance evaluated was within National Forests.

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[1]Channel Condition Classification by Walter F. Megahan, Intermountain Region, Forest Service, Ogden, Utah.

The eight watersheds inventoried were selected because they provide most of the tributary inflow in the Basin. The inventory sample included 188 miles of the total 367 miles of stream within these 8 watersheds. These streams have, in many instances, reached equilibrium between channel depth and width in relation to streamflow despite past erosion problems. Coal Creek Watershed had the highest percentage of rapidly eroding stream channels.

TABLE 3.--Stream channel conditions in selected watersheds, Beaver River Basin, 1968

Watershed		Stream length[a]	Stream channel erosion condition		
			Stable	Moderate	Rapid
		Miles	Miles	Miles	Miles
2A-24	Chalk Creek	46.2	0	26.4	19.8
2A-25	Corn Creek	49.4	8.1	25.0	61.3
2B-1	Beaver	124.7	70.0	29.3	25.4
2B-2	Wildcat Creek	9.7	7.7	0	2.0
2B1-1	Coal Creek	71.7	21.7	8.6	41.4
2B1-3	Red Creek	21.5	7.4	5.1	9.0
2B2-1	Pinto Creek	27.3	8.9	10.4	8.0
2B2-2	Shoal Creek	61.9	5.1	9.5	2.3
Basin total		367.4	128.9	114.3	124.2
Percentage			35%	31%	34%

[a] Perennial stream above first irrigation diversion.

SEDIMENT YIELD FROM CRITICAL AREAS

Critical areas are defined as: (1) areas of erosion greater than .005 inches per year or 0.266 acre feet per square mile, (2) lands yielding significant amounts of irrigation water or, (3) areas with watersheds producing perennial streams with high value for fishing, culinary supply or power generation.

Critical areas are divided into primary and secondary areas. Primary critical areas are eroding at a rate greater than .010 inches per year. Secondary critical areas are eroding at a rate of .005 to .010 inches per year. Primary critical areas are also divided into those areas where erosion has been accelerated by activities, such as overgrazing, and those areas where erosion is normal or geologic.

Primary critical areas of accelerated erosion are those most in need of watershed stabilization. Secondary areas are suitable for such treatment but of lesser priority. Areas of normal erosion are not suitable for watershed stabilization work. These delineations are basic in evaluating watershed stabilization opportunities described in Appendix V. Critical areas for selected drainages are indicated in Table 4.

Gross erosion on critical areas was computed in a manner similar to that in the previous section. Based on the calculated gross erosion, a delivery ratio was computed to determine the amount or percentage of eroding soil delivered to the point of evaluation. The point of evaluation was approximately the first irrigation diversion, which is also generally the upper limit of the water budget areas. However, Wildcat Creek Watershed was evaluated to the Minersville Reservoir. Some drainages passed through small areas of cultivated land before reaching the valley floor. These drainages, such as Pinto Creek, were evaluated to the water budget area in the valley.

In some drainages, rates of sediment deposition in irrigation reservoirs have been measured. In other drainages sediment yields were estimated in connection with feasibility studies of proposed reservoirs. Also, limited sampling of suspended sediment was tabulated and analyzed in Appendix I. These served as parameters for estimations of delivery ratios.

Extrapolations were made from these measurements and data to watersheds lacking information on sedimentation, by using two factors: (1) Relief-Length Ratio[1] , wherein the difference between the maximum elevation of the drainage and the elevation at the point of evaluation in feet, is divided by the length of the stream in feet (variations in this ratio are then utilized to compute delivery ratios), and (2) Drainage Density Ratio[2] , wherein the area of each drainage in square miles divided by the area of stream in acres (estimated from the length). Again variations in this ratio are utilized to vary computed delivery ratios. Gross erosion from critical areas, delivery ratios, and sediment yield are indicated in Table 5.

Table 6 presents a comparison of erosion and sediment yield from primary and secondary areas, and Table 7 indicates damage value of sediment produced.

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[1] Mayer, Sam B., "Factors Affecting Sediment Delivery Rates in the Red Hills Physiographic Area", Trans-American Geophysical Union Vol. 39, No. 4, Aug. 1958, pages 669-675.

[2] Roehl, John W., "Sediment Source Areas, Delivery Ratios and Influencing Morphological Factors", presented at Symposium on Land Erosion, October 1962 (unpublished).

TABLE 4.--Acreage of primary and secondary critical areas by drainage, Beaver River Basin

Watershed	Drainage	Drainage above water budget boundary	Critical area			
			Secondary	Primary		Total
				Accelerated erosion	Normal erosion	
		(Acres)	(Acres)	(Acres)	(Acres)	(Acres)
2A-24	Chalk Creek	28,780	16,170	8,280	0	24,450
2A-24	Pine Creek	3,840	2,460	390	0	2,850
TOTAL 2A-24		32,620	18,630	8,670	0	27,300
2A-25	Meadow Creek	9,190	5,770	1,390	0	7,160
2A-25	Corn Creek	56,960	19,030	5,020	0	24,050
2A-25	Walker & Dry	5,530	210	3,420	0	3,630
TOTAL 2A-25		71,680	25,010	9,830	0	34,840
2B-2	Indian Creek	11,760	6,480	4,420	0	10,900
2B-2	Wildcat Creek	90,120 [a]	39,020	30,400	0	69,420
TOTAL 2B-2		101,880	45,500	34,820	0	80,320
2B-1	North Creek	23,690	19,520	0	0	19,520
2B-1	Beaver River	59,790	6,470	2,810	0	9,280
2B-1	South Creek	21,290	7,510	420	0	7,930
TOTAL 2B-1		104,770	33,500	3,230	0	36,730
2B1-3	Little Creek	12,720	6,310	6,410	0	12,720
2B1-3	Red Creek	16,310	10,510	4,300	0	14,810
TOTAL 2B1-3		29,030	16,820	10,710	0	27,530
2B1-1	Parowan Creek	31,150	5,600	4,860	13,190	23,650
2B1-1	Summit Creek	17,900	6,240	10,890	220	17,350
2B1-1	Braffits Cr.	7,560	0	6,560	1,000	7,560
2B1-1	Fiddlers Cr.	9,480	0	6,660	1,900	8,560
2B1-1	Coal Creek	50,230	850	30,880	16,670	48,400
2B1-1	Shurtz Creek	17,140	0	14,810	1,230	16,040
TOTAL 2B1-1		133,460	12,690	74,660	34,210	121,560
2B1-4	Quichapa Cr.	4,450	0	4,450	0	4,450
TOTAL 2B1-4		4,450	0	4,450	0	4,450
2B2-1	Pinto Creek	36,760	6,640	4,430	1,410	12,480
2B2-1	Little Pinto	46,390	13,070	4,950	6,940	24,960
2B2-1	Meadow Creek	21,700	17,800	3,900	0	21,700
TOTAL 2B2-1		104,850	37,510	13,280	8,350	59,140
2B2-2	Spring Creek	16,060	7,770	0	520	8,290
2B2-2	Shoal Creek	94,450	76,930	13,060	0	89,990
TOTAL 2B2-2		110,510	84,700	13,060	520	98,280
TOTAL		693,250	274,360	172,710	43,080	490,150

[a] Includes entire area above Minersville Reservoir.

TABLE 5.--Estimated sediment yield from selected drainages to water budget areas, Beaver River Basin

Watershed	Drainage	Area above point of evaluation (Square Mile)	Annual gross erosion from critical areas (Acre-feet)	Delivery ratio based upon evaluated factors	Annual sediment yield[2] (Acre-feet)	(Acre-feet per Square Mile)
2A-24	Chalk Creek	44.97	20.4	.88	18.0	0.40
2A-24	Pine Creek	6.00	2.0	.42	0.8	0.13
TOTAL 2A-24		50.97	22.4		18.8	
2A-25	Meadow Creek	14.36	5.3	.32	1.6	0.11
2A-25	Corn Creek	89.00	18.2	.31	5.5	0.06
2A-25	Walker & Dry	8.64	4.4	.33	1.4	0.16
TOTAL 2A-25		112.00	27.9		8.5	
2B-2	Indian Creek	18.38	9.6	.22	2.1	0.11
2B-2	Wildcat Creek	140.81[1]	62.4	.16	10.0	0.07
TOTAL 2B-2		159.19	72.0		12.1	
2B-1	North Creek	37.02	12.2	.68	8.3	0.22
2B-1	Beaver River	93.42	7.5	.28	2.1	0.02
2B-1	South Creek	33.27	5.2	.24	1.2	0.04
TOTAL 2B-1		163.71	24.9		11.6	
2B1-3	Little Creek	19.88	11.9	.25	3.0	0.15
2B1-3	Red Creek	25.48	12.0	.23	2.7	0.11
TOTAL 2B1-3		45.36	23.9		5.7	
2B1-1	Parowan Creek	48.67	26.1	.65	17.0	0.35
2B1-1	Summit Creek	27.97	17.8	.52	9.2	0.33
2B1-1	Braffits Creek	11.81	9.4	.83	7.8	0.66
2B1-1	Fiddlers Creek	14.81	10.7	.23	2.5	0.17
2B1-1	Coal Creek	78.48	59.9	.91	54.4	0.69
2B1-1	Shurtz Creek	26.78	20.0	.41	8.2	0.31
TOTAL 2B1-1		208.52	143.9		99.1	
2B1-4	Quichapa Creek	7.11	5.6	.29	1.6	0.22
TOTAL 2B1-4		7.11	5.6		1.6	
2B2-1	Pinto Creek	57.44	23.1	.14	2.7	0.05
2B2-1	Little Pinto	72.48	11.4	.12	1.6	0.02
2B2-1	Meadow Creek	33.91	16.0	.18	2.9	0.08
TOTAL 2B2-1		163.83	50.5		7.2	
2B2-2	Spring Creek	25.09	5.4	.27	1.5	0.06
2B2-2	Shoal Creek	147.57	160.5	.13	20.8	0.14
TOTAL 2B2-2		172.66	165.9		22.3	
TOTAL		1,083.35	537.0		186.9	

1 Includes entire area above Minersville Reservoir.

2 Based upon hydrologic and morphological factors.

TABLE 6.--Comparison of annual gross erosion and sediment yield from primary and secondary critical areas, Beaver River Basin

Watershed	Drainage	Gross Erosion			Sediment Yield		
		Secondary	Primary		Secondary	Primary	
			Accelerated	Normal		Accelerated	Normal
		Acre-feet					
2A-24	Chalk Creek	10.1	10.3	-	8.9	9.1	-
2A-24	Pine Creek	1.5	0.5	-	0.6	0.2	-
TOTAL 2A-24		11.6	10.8	-	9.5	9.3	-
2A-25	Meadow Creek	3.6	1.7	-	1.1	0.5	-
2A-25	Corn Creek	11.9	6.3	-	3.6	1.9	-
2A-25	Walker & Dry	0.1	4.3	-	-	1.4	-
TOTAL 2A-25		15.6	12.3	-	4.7	3.8	-
2B-2	Indian Creek	4.1	5.5	-	0.9	1.2	-
2B-2	Wildcat Creek	24.4	38.0	-	3.9	6.1	-
TOTAL 2B-2		28.5	43.5	-	4.8	7.3	-
2B-1	North Creek	12.2	-	-	8.3	-	-
2B-1	Beaver River	4.0	3.5	-	1.1	1.0	-
2B-1	South Creek	4.7	0.5	-	1.1	0.1	-
TOTAL 2B-1		20.9	4.0	-	10.5	1.1	-
2B1-3	Little Creek	3.9	8.0	-	1.0	2.0	-
2B1-3	Red Creek	6.6	5.4	-	1.5	1.2	-
TOTAL 2B1-3		10.5	13.4	-	2.5	3.2	-
2B1-1	Parowan Creek	3.5	6.1	16.5	2.3	4.0	10.7
2B1-1	Summit Creek	3.9	13.6	0.3	2.0	7.1	0.1
2B1-1	Braffits Creek	-	8.2	1.2	-	6.8	1.0
2B1-1	Fiddlers Creek	-	8.3	2.4	-	1.9	0.6
2B1-1	Coal Creek	0.5	38.6	20.8	0.4	35.1	18.9
2B1-1	Shurtz Creek	-	18.5	1.5	-	7.6	0.6
TOTAL 2B1-1		7.9	93.3	42.7	4.7	62.5	31.9
2B1-4	Quichapa Creek	-	5.6	-	-	1.6	-
TOTAL 2B1-4		-	5.6	-	-	1.6	-
2B2-1	Pinto Creek	4.1	5.5	1.8	0.6	0.8	0.2
2B2-1	Little Pinto	8.2	6.2	8.7	1.0	0.7	1.0
2B2-1	Meadow Creek	11.1	4.7	-	2.0	0.9	-
TOTAL 2B2-1		23.4	16.4	10.5	3.6	2.4	1.2
2B2-2	Spring Creek	4.8	-	0.6	1.3	-	0.2
2B2-2	Shoal Creek	48.0	96.2	16.3	6.2	12.5	2.1
TOTAL 2B2-2		52.8	96.2	16.9	7.5	12.5	2.3
TOTAL		171.2	295.5	70.1	47.8	103.7	35.4

TABLE 7.--Estimated annual sediment yield damages from selected drainages, Beaver River Basin, 1969

Watershed	Drainage	Sediment Yield		Damages[a]
		Acre-feet	Cubic yards	Dollars
2A-24	Chalk Creek	18.0	29,034	$ 8,710
2A-24	Pine Creek	0.8	1,290	387
TOTAL 2A-24		18.8	30,324	9,097
2A-25	Meadow Creek	1.6	2,581	774
2A-25	Corn Creek	5.5	8,872	2,662
2A-25	Walker & Dry Creek	1.4	2,258	677
TOTAL 2A-25		8.5	13,711	4,113
2B-2	Indian Creek	2.1	3,387	1,016
2B-2	Wildcat Creek	10.0	16,130	4,839
TOTAL 2B-2		12.1	19,517	5,855
2B-1	North Creek	8.3	13,388	4,017
2B-1	Beaver River	2.1	3,387	1,016
2B-1	South Creek	1.2	1,936	581
TOTAL 2B-1		11.6	18,711	5,614
2B1-3	Little Creek	3.0	4,839	1,452
2B1-3	Red Creek	2.7	4,355	1,307
TOTAL 2B1-3		5.7	9,194	2,759
2B1-1	Parowan Creek	17.0	27,421	8,226
2B1-1	Summit Creek	9.2	14,840	4,452
2B1-1	Braffits Creek	7.8	12,581	3,774
2B1-1	Fiddlers Creek	2.5	4,032	1,210
2B1-1	Coal Creek	54.4	87,747	26,324
2B1-1	Shurtz Creek	8.2	13,227	3,968
TOTAL 2B1-1		99.1	159,848	47,954
2B1-4	Quichapa Creek	1.6	2,581	774
TOTAL 2B1-4		1.6	2,581	774
2B2-1	Pinto Creek	2.7	4,355	1,307
2B2-1	Little Pinto	1.6	2,581	774
2B2-1	Meadow Creek	2.9	4,678	1,403
TOTAL 2B2-1		7.2	11,614	3,484
2B2-2	Spring Creek	1.5	2,420	726
2B2-2	Shoal Creek	20.8	33,550	10,065
TOTAL 2B2-2		22.3	35,970	10,791
TOTAL		186.9	301,470	90,441

[a] Damages evaluated at 30¢ per cubic yard.

This procedure does not adequately take into account sediment yield during flash floods which often produce large volumes of sediment in very short periods. Because the procedure is based on erosion rates modified by characteristics of the land, results may be conservative for frequently flooding streams, such as Coal Creek.

SEDIMENT DEPOSITION

Sediment deposition is a major problem in most reservoirs. It reduces available storage for irrigation and recreation, decreases water quality, and often destroys esthetic values. Non-consumptive use of water such as swimming and boating are not popular in many reservoirs because of suspended sediment. Sediment deposition in selected reservoirs is shown in Table 8.

Sediment in streams results in damage to trout habitat, causes a loss of esthetic value, and limits the use that can be made of the water. Heavy sediment-laden water can smother trout by impairing the functioning of the gills. Lesser amounts of sediment cause an abrasive action on gill covers of fish that over a period of time can also result in increased mortality. Sediment also covers stream bed vegetation that is necessary to support insect life, the principal food of trout. Productivity of streams is directly related to their freedom from silt (refer to Appendix I). Spawning areas must also be free from silt. Presently, natural reproduction is limited primarily because of this problem.

Deposition of sediment in irrigation systems is an annual problem in many areas of the basin. When floods occur, each canal diverts a portion of the sediment into the irrigation system. Many irrigation canals and ditches also intercept floodwater from overland flow resulting in heavy accumulations of sediment. The greatest deposition is usually at the head of the canal where water is diverted.

Serious sediment problems exist in irrigation systems in the Coal Creek Watershed. Sediment not only enters the systems during flood flows and high runoff periods, but considerable sediment also enters the systems during low flows due to erosion on Coal Creek Watershed.

The most spectacular and damaging sediment deposition is frequently associated with flooding in urban and residential areas. Streets, homes, and businesses are often damaged extensively with mud. Sediment deposited on sidewalks, streets and yards disrupts traffic and damages lawns, shrubbery, and gardens.

TABLE 8.--Sediment deposition in selected reservoirs, Beaver River Basin

Item[a]	Unit	Name : / Stream : / Site number[b]:	Reservoir				
		Name	Minersville	Beaver Dam #1	Yankee Meadow[d]	Enterprise Upper #1	Chalk Cr. D.B.
		Stream	Beaver	Indian	Bowery	Little Pine	Chalk Creek
		Site number	2B-3G	2B-2B	2B1-1E	2B2-2B	2A-24A
Total drainage area	Sq.-mi.		510	12	7	27	60.8
Sediment contributing area	Sq.-mi.		490	12	7	27	60
Average annual water inflow	Ac.-ft.		27,500	1,110	1,070	(e)	27,960
Structure age (1965)	Years		50	66	27	55	29
Original capacity	Ac.-ft.		26,500	350	975	9,000	46
Present capacity (1965)	Ac.-ft.		23,260	320	835	8,500	0
Sedimentation:							
Total	Ac.-ft.		3,240	30	140	500	46[c]
Average annual	Ac.-ft.		64.8	0.45	5.2	9.2	(e)
Average annual rate	Ac.-ft./Sq. mi.		0.132	0.038	0.74	0.34	(e)
Average annual storage capacity loss	Percent		0.24	0.13	0.53	0.10	(e)

[a]Additional information for existing reservoirs given in Appendix II.
[b]Site number is for reference only for location on map in Appendix II.
[c]Debris basin filled the same year it was built.
[d]Data since enlargement.
[e]Data not evaluated.

Virtually all communities in the basin are damaged from sediment deposition at one time or another. This is due mainly to the location of these communities on alluvial fans and floodplains. Sediment problems in the urban and residential areas are nearly always associated with floods. Sediment damage in Cedar City is more than in other communities because floods are more frequent and floodwaters carry larger volumes of sediment.

Sediment deposited on cropland smothers vegetation, delays tillage operations, disrupts irrigation, and changes the topography. These depositions vary from thin layers of very fine silt and clay to several inches of gravel and debris. Crops have to be replanted in many cases and fields have to be releveled to obtain proper irrigation. If fine textured sediments are tilled into the existing soils, this often reduces infiltration rates and crop production. In some areas, cropland has been abandoned due to large deposits of sediment.

Chapter II

F L O O D   D A M A G E S

Flood damages occur on three major categories of land: Forest and range, urban and industrial, and agricultural. Forest and range damages include those to fish habitat, esthetics, recreation facilities, transportation facilities, and land productivity.

Newspaper and other accounts describe historical flood damages rather broadly. Recent flood reports are generally more descriptive of damages associated with specific floods. Brief excerpts of reported floods appear at the back of this appendix as a Supplement. A hydrologic and economic analysis was made of flood damages associated with various frequency events. Damages were based on 1970 conditions. Reported flood damages may not agree with projected damages shown herein since these are average values. No attempt was made to describe total damages occuring on forest and range lands.

FILLMORE SUBBASIN

EUREKA AREA

Tintic Wash drains the hills surrounding Eureka. Each tributary contributes floodwater during major storms and many of them flow through Eureka. The peak flows from these drainages are generally small and associated flood damages are also generally small, but have on occasion caused inconvenience and damage. The chronology in the Historic Floods Supplement includes accounts of all damages, whereas peak flows and corresponding damages described here pertain to the major drainage through Eureka, generally following Main Street from the northeast.

A peak flow series was developed for the 0.3 square mile drainage entering Eureka from the northeast. Analysis was made by assuming rainfall amounts for a two hour storm. The values used compared favorably with average values for Utah watersheds.

Depth of flooding for peak flows was computed assuming any flood would continue down the main street (U.S. Highway 6-50) after leaving the channel. Peak flows and depth of flooding for selected frequencies are:

Frequency	Peak flow	Depth of flooding
Percent	C.F.S.	Feet
1	365	0.6
2	265	0.5
4	190	0.4
10	125	0.4
20	70	0.3
50	27	0.2

Some businesses, homes, roads, and other facilities at Eureka have been damaged by floods. In anticipation of a continual flood threat, the city installed a closed flood channel bordering the highway through town. This concrete pipe has a carrying capacity of approximately 150 cfs. Some development has occurred on top of this channel. In addition, floodwater can be by-passed by the highway. At the west end of Eureka, the highway provides a floodway since it is below surrounding ground levels.

To estimate present flood damages from the flood frequency series, several assumptions were made. The average values of structures and contents were estimated from visual observation and by relating to values in other areas. Inside-building flood water depths were assumed and damage values extrapolated using the procedures in a study titled, "A Study of Procedure in Estimating Flood Damage to Residential, Commercial, and Industrial Properties in California".

Measureable flood damage was assumed to begin at the ten percent chance storm. The closed flood channel was assumed to plug at the four percent chance flood. The one percent flood was estimated to cause $10,700 damages. The average annual flood damage was estimated at $420.

CHALK CREEK

Chalk Creek originates in the mountains approximately 12,000 feet above sea level and flows westward toward Flowell. Surface water is diverted for irrigation and used to recharge the ground-water reservoir. Fillmore is on bench lands adjacent to Chalk Creek with some homes and business establishments in the flood plain. Most of the surface flows dissipate by the time they reach Flowell.

A peak flow series for Chalk Creek was developed using a log-normal procedure. Historical floods were combined with the 1944-1967 annual summer flow series to approximate peak flows.

The flood plain was divided into an upper and lower area based on type of flooding. Stage-area inundated relationships were used to analyze the upper area (U.S. Highway 91 crossing to a point one mile downstream). The lower area was assumed to have a flood plain flow relationship. Area inundated was estimated assuming the major volume of flooding would be carried under Highway 91 at Fillmore and also assuming that existing diversions will reduce flows by 350 cfs. The latter assumptions would have negligible effect on large floods.

Peak flows and area inundated for selected flood frequencies are:

Frequency	Peak flow	Area flooded		
		Upper	Lower	Total
Percent	C.F.S.	Acres	Acres	Acres
1	3,000	58	1,090	1,148
2	2,500	54	900	954
4	1,950	32	680	712
10	1,200	20	395	415
20	625	0	160	160
50	100	0	0	0

Floods historically have caused considerable damage to homes, businesses, roads and cropland on the flood plain. In 1936 a debris basin was constructed by the Civilian Conservation Corps (CCC) and filled with sediment the same year. However; the structure still significantly reduces flood peaks even though sediment is now carried over the spillway.

During the 1950's the Chalk Creek Watershed was authorized for PL 566 (Small Watershed) planning. Local sponsors rejected some features of the proposed project and planning activities were terminated. The Forest Service concluded from their investigation that the watershed was in poor condition and treatment should be carried out on critical areas as funds became available. Succeeding treatment includes 1,546 acres of contour trenching and 2,641 acres of grass seeding.

Damages for the one and ten percent floods were estimated at $101,000 and $27,000, respectively. The average annual flood damage was estimated at $7,600.

MEADOW CREEK

The town of Meadow is located on the Meadow Creek flood plain about two miles west of the canyon mouth. Two flood control structures have been constructed on the main channel. These structures combined with land treatment in the headwaters have largely eliminated the flood hazard.

CORN CREEK

Kanosh, a town of about 500 residents, is on the Corn Creek flood plain. Surface water during the winter months spreads over the flood plain west of town and helps recharge the ground-water reservoir. Flood flows formerly spread over portions of the town but a debris basin constructed at the mouth of the canyon has largely eliminated flood damages.

Probable peak flows were estimated using log-normal procedures. The resulting "probable" 50 percent chance flow was adjusted to 85 cfs to compensate for a skew effect due to shortage of available records. Flood volumes were estimated from six-hour rainfall depths at the selected chance of reoccurrence. Following are peak flows, flood volumes, sediment volumes and estimated affected areas for selected frequencies.

Frequency	Peak flow	Runoff volume	Sediment volume	Area flooded
Percent	C.F.S.	Acre-feet	Acre-feet	Acres
1	1,630	277	110	554
2	1,160	171	73	342
4	790	106	46	212
10	435	59	15	118
20	248	32	8	64
50	85	5	1.2	10

Residual flood damages beyond those that the existing structure prevents were estimated to be $980 annually, while the 1 percent and 10 percent flood damages were projected at $19,700 and $1,800, respectively. Measurable residual damages would occur at about the 30 percent frequency flood.

WIDE MOUTH CANYON NEAR KANOSH

This drainage has only intermittent surface water flows from spring snowmelt and intense rainstorms. The latter produce noticeable runoff which causes flooding. Damages on the flood plain are generally low except for those to the highway and interruption of traffic.

BEAVER-MILFORD SUBBASIN

BEAVER RIVER

Beaver River originates in the Tushar Mountains east of Beaver and flows to the west and north. Beaver, Greenville, Adamsville, Minersville, and Milford lie near the river channel. Minersville Reservoir controls most of the river flow below Adamsville, essentially eliminating flooding from the Beaver River at Minersville and Milford.

The Beaver River system was analyzed for both spring and summer flood conditions. Synthetic log-normal series were developed for each condition using records dating back to the early 1900's for the Geological Survey gage above Beaver.

Essentially the same area will be damaged regardless of when the flood occurs. Peak flows associated with low frequency events are produced by summer floods while peak flows associated with more frequent events are produced by spring snowmelt. Stage-area inundated relationships were used to compute the flooded area for each event. Reduction in peak flow due to routing effects was estimated at five percent per mile.

Peak flows and area inundated for selected frequencies are:

Frequency Percent	Peak flow C.F.S.	Area flooded Acres
1	1,850	362
2	1,080	244
4	670	137
10	560	107
20	470	80
50	335	50

Historically, the Beaver River has not produced large damaging floods. Many factors, including good watershed conditions, appear responsible for this situation. The river channel has a large flood capacity before measurable damage begins. Highway bridges have sufficient capacity to permit large volumes of water to pass without restriction. Suitable land near the Beaver River has encouraged business and residential development on benches above the flood plain.

Pastures, trees, and phreatophytes make up the bulk of vegetation growing on the flood plain. Some stock yards and livestock feed-yards border the river and other limited improvements could be flooded during infrequent flood events. Fences across the river are highly susceptible to flood damage. Property owners often install temporary fences of less cost, thereby reducing potential flood damages.

Flood damages were estimated on the basis of area flooded and value of property damaged. The one percent event flood was estimated to cause $21,000 in damages. Flood damages at the 10 percent chance flood event were estimated at $6,000. Average annual estimated flood damages were $2,000.

NORTH CREEK

North Creek is tributary to Beaver River. Normal flows are diverted for irrigation use before reaching the River.

Records are not available to develop a historical flood series. A flood series for North Creek was developed from correlations with the Beaver River. Correlations were made by using cubic feet per second per square mile (CSM) -watershed area relationships developed from past floods in the State of Utah.

The projected flooded areas for each event was computed from stage-area inundated relationships. Below is a tabulation of peak flow and area inundated for selected frequencies:

Frequency Percent	Peak flow C.F.S.	Area flooded Acres
1	1,295	467
2	720	233
4	450	115
10	173	12
20	76	5
50	17	-

North Creek has not caused serious flood damages historically. Potential flood damages were estimated from an inventory of damageable property on the flood plain in relation to acres flooded, by frequency. The one percent flood damages were estimated at $21,000 whereas the 10 percent flood damages were estimated to be $4,000. The average annual flood damage was estimated to be $1,200.

SOUTH CREEK

South Creek is tributary to Beaver River. Like North Creek, water originating in this drainage is mostly diverted for irrigation use before reaching the River. Historical records were not adequate to develop a flood peak series and average CSM rates from other watersheds in the Basin were used to derive the series. Flooded area for each expected event was calculated by stage-area inundated relationships.

Peak discharge and area inundated for selected frequencies are shown on the following page.

Frequency Percent	Peak flow C.F.S.	Area flooded Acres
1	900	152
3	590	117
4	380	71
10	190	7
20	100	-
50	30	-

The flood plain grows forage and grain crops used for livestock production;and homes or businesses are not located here. Floodwater and normal flows are diverted to irrigate crops grown on the flood plain and adjacent areas. Only the infrequent flood events would cause damages of any consequence. Flood damages were estimated for the one percent event to be $6,000, and the 10 percent event to be $750. The average annual flood damages were estimated at $320.

MILFORD

Although the town of Milford borders the Beaver River, floods are caused by overland flows originating in the hills west of town. Floodwaters from these side drainages have caused extensive flood damages to town property in the past.

Floods originating in Big Wash have caused frequent damage to Milford property. Other side drainages occasionally produced floodwater. During the late 1950's, the local people asked the Corps of Engineers to investigate feasibility of a flood control structure on Big Wash to protect Milford. This structure was later constructed and since then flood damages have been largely eliminated from this source.

CEDAR-PAROWAN SUBBASIN

RED CREEK AT PARAGONAH

Red Creek flows through Paragonah and on to the valley floor. A reservoir on the main channel prevents floods and stores water for late season use. A hydroelectric power plant utilized a collection system, including diversions and dikes, which have also prevented damaging floods from reaching town.

PAROWAN

Center Creek runs through the south part of the city of Parowan. This creek furnished water for power generation and irrigation. Homes, businesses and other developments have been constructed on the flood plain and are susceptible to flood damages.

Center Creek drains low lying hills having very little vegetation. Rock outcrops and bare soil coupled with low infiltration rates cause large floods following intensive rainstorms. A synthetic flood series was derived to estimate flood damages. The following tabulation shows peak flows and areas flooded by frequency.

Frequency	Peak flows	Area flooded		
		Residential	Agricultural	Total
Percent	C.F.S.	Acres	Acres	Acres
1	4,000	405	2,295	2,700
2	2,900	230	1,370	1,600
4	2,100	110	750	860
10	1,300	0	300	300
20	820	0	90	90
50	340	0	0	0

Field investigations determined the damageable values situated in the flood plain. Once these were determined, actual damages were extrapolated from Coal Creek with appropriate adjustments. Sediment damages were estimated independently and are based on estimates of sediment accumulation in ditches, on cropland, and in residential areas. The one percent flood damage was estimated to be $495,000 while the ten percent flood event was estimated to cause $15,000 in damages. The average annual flood damage was estimated to be $22,720 based on both sediment and direct flood damages.

SUMMIT

Summit Creek originates in the mountainous area east of the town of Summit. Because of the flood hazard the CCC work force constructed a debris basin above the community during the 1930's. Since then, much of the sediment capacity has been filled but floodwater retarding capacity still remains. Flood peaks are significantly reduced by the debris basin.

Floodwater has caused damages to residential and agricultural lands. The following tabulation shows peak flows and areas flooded by frequency:

Frequency	Peak flow	Area flooded		
		Residential	Agricultural	Total
Percent	C.F.S.	Acre	Acre	Acre
1	3,100	100	1,900	2,000
2	2,200	65	1,035	1,100
4	1,500	20	470	490
10	800	0	95	95
20	450	0	0	0
50	140	0	0	0

Flood damage estimates were made by extrapolating damage from Coal Creek with necessary adjustments to reflect the physical situation prevailing in this drainage. The one percent flood was projected to cause $183,000 in damages while the 10 percent flood event was projected to cause $4,000 in damages. The average annual flood damage was estimated at $7,940.

FIDDLERS CANYON

Fiddlers Canyon does not have a continuous flow of water throughout the year but is limited generally to snowmelt periods and floods. Two major highway systems, a few homes, and irrigated cropland lie on the flood plain. Irrigation delivery canals have also been damaged by past floods. The upper watershed consists of highly erosive low hills and soils with low infiltration rates. High intensity storms result in rapid runoff that carries large amounts of sediment.

The one percent flood is projected to yield a peak flow of 2,900 cfs resulting in 480 acre-feet of runoff. This flow is projected to flood 2,200 acres. The following tabulation shows relationship between peak flow and areas flooded by frequency.

Frequency Percent	Peak flow C.F.S.	Area flooded Acres
1	2,900	2,200
2	2,400	1,700
4	1,950	1,200
10	1,400	750
20	1,000	450
50	450	135
70	200	40

Flood damages were extrapolated from damages identified in Coal Creek. The one percent flood was projected to cause $80,000 in damages while the 10 percent flood event was projected at $18,600. The average annual flood damage was projected at $10,400. This estimate also includes sediment damages.

DRY CANYON

Dry Canyon, bordering Coal Creek on the north does not have a continuous streamflow. Only flash floods generate enough water volume to reach the developed area.

This drainage, like the lower reaches of Coal Creek, drains bare low hills. The one percent peak flow was estimated at 870 cfs and would yield 86 acre-feet. This quantity would inundate approximately 300 acres.

Flood damages were extrapolated from the Coal Creek flood damage estimate. Total annual damages were estimated to be $17,150 including residential, $2,870; commercial, $7,730; agriculture, $1,310; sediment, $2,460; other, $860 and indirect, $1,920.

COAL CREEK

Coal Creek originates in Cedar Breaks National Monument. Steep slopes coupled with relatively low infiltration rates, contribute significantly to the flood condition and rapid water runoff. Floods are common throughout the year, but have occurred more frequently in July and August than any other two-month period.

Cedar City is situated at the mouth of Coal Creek. Most community development has occurred on bench lands adjacent to the creek channel but roads, bridges, and some homes and other developments have been constructed on the flood plain. Severe flood damages have occurred to these properties.

Floods are generally of short duration and range in magnitude from a few cfs to more than 6,000 cfs. Floodwaters from Cedar Breaks National Monument contain an unusually high percentage of fine, red suspended sediments while other floodwaters originating at lower elevation are generally brown in color.

Coal Creek drains highly erosive low lying hills. Some large areas consist of sheer cliffs while others have a soil layer devoid of vegetation. The area is in a storm path characteristic of frequent thunderstorm activity. This type storm yields small amounts of precipitation but in a very short period of time and with great intensity. Precipitation from rain or hail storms of high intensity cannot be absorbed.

Peak flows and areas flooded for various frequencies are shown below:

Frequency	Peak flow at USGS Gage	Area flooded		
		Residential	Agricultural	Total
Percent	C.F.S.	Acre	Acre	Acre
1	6,400	590	3,485	4,075
2	5,000	520	2,865	3,385
4	3,850	345	2,150	2,495
10	2,600	122	1,325	1,447
20	1,750	35	727	762
50	850	0	50	50

Authorization under PL 566 to plan the Coal Creek Watershed permitted a rather complete flood damage analysis. Inventories were made of damages sustained by flood plain residents for specific floods. A synthetic flood flow series was projected in residential sections and on agricultural land. Floodwater depths inside homes were projected from flood flow depths. Commercial and other damages were also inventoried for specific floods and then related to other flood events. Agricultural damages were developed in a similar manner. The one percent chance flood was projected to cause $2,000,000 damages. The 10 percent flood total damages were projected at $200,000. Some damages would be experienced at a decreasing rate to the 90 percent chance storm. Sediment and other less spectacular damages would continue to add to total losses for less frequent flood events. The average annual estimated flood damages was $304,880.

ESCALANTE DESERT SUBBASIN

PINTO CREEK

Pinto Creek originates in the Pine Valley Mountains and flows north ward. In some sections erosion and sediment conditions are critical problems. Severe flooding has occurred on land bordering Pinto Creek and the upper reaches are still subject to flood damage. Newcastle Reservoir, on the main channel near the town of Newcastle, was constructed in the late 1950's. This structure now prevents downstream flood damage.

SHOAL CREEK

Shoal Creek drains an area primarily west of the town of Enterprise on the north face of the Pine Valley Mountains. Several smaller drainages, such as Little Pine Creek, are tributaries to this major drainage, and Upper and Lower Enterprise Reservoirs are located on this tributary. Enterprise could experience some flood damage if large flows exceed the channel capacity. Eventually floodwater dissipates itself on the flood plain between Enterprise and Beryl Junction, on undeveloped land. Large sustained flood flows reach beyond the undeveloped area. Floodwater occasionally inundates many acres of nearly flat irrigated land at Beryl Junction.

Few floods have caused extensive damage to agricultural lands and improvements situated on the flood plain. Upper and Lower Enterprise Reservoirs retain most of the flow originating above them except for the less frequent events and could contain some of these events if properly operated. Above Enterprise, the existing channel has a very large capacity, and has been maintained by adjacent property owners to insure protection. Below Enterprise, for a distance of about three miles, the flood plain contains unimproved land growing sagebrush and other native vegetation.

Shoal Creek channel extends through the community of Enterprise and through the area directly north and east of town. The channel will contain all the projected winter runoff and the more frequent summer flows (up to the four percent event). Less frequent summer flows will overtop the channel east of Enterprise and flood agricultural lands and possibly a few homes.

At Beryl Junction the flood channel has been filled in and cultivated. Roads, homes, potato cellar, and other improvements have been constructed on the flood plain. Their presence during floods cause ponding and increase damages.

The analysis of Shoal Creek was broken between summer and winter flows because of the areas affected. Summer storms usually produce high instantaneous peaks, but lack sufficient volume to carry across the barren flood plain north of Enterprise. Winter flows are less intense but contain a high volume of flow.

Two flood damage areas were identified. Summer floods at approximately the four percent event were projected to overtop the existing channel and cause damage to irrigated lands north of Enterprise. Winter floods are of sufficient flow that lands would be flooded further north at Beryl Junction.

Following is a tabulation of peak discharge, volume of runoff and inundated area for both summer and winter floods for selected frequencies. Peak discharges were determined for summer storms using historical peak discharges and estimated return intervals. Lack of records made it impossible to develop a flood series using normal procedures.

	Summer			Winter		
Frequency Percent	Peak flow C.F.S.	Volume of flood Acre-feet	Area flooded Acres	Peak flow C.F.S.	Volume of flood Acre-feet	Area flooded Acres
1	3,600	740	1,380	2,000	2,250	4,700
2	2,150	456	810	1,200	1,750	2,350
4	890	218	80	900	1,380	1,080
10	500	135	-	400	900	170
20	220	53	-	150	610	60
50	46	30	-	50	290	12

The flood of March-April, 1969 was estimated to be a four percent event based on the memory of local people and correlation with December-March precipitation. Other winter flood events were proportioned by judgment from the existing data. Both summer and winter flood series were based more on judgement than actual records. A detailed analysis was not made at this level of investigation.

Potential crop damage stemming from summer floods was computed. The one percent chance flood was projected to cause damages amounting to $98,000 while the four percent flood would cause $5,000 in damages. Essentially no agricultural damages would be caused by more frequent floods as flows would dissipate in undeveloped areas. Average annual flood damages were projected to be $2,200.

Winter flood damages were estimated from a large flood during March and April, 1969. The Enterprise reservoirs were allowed to remain full despite a heavy snow pack and forecasts of heavy runoff, which was a contributing factor to flooding. This snowmelt flood deposited large volumes of sediment on irrigated cropland. Planting of potatoes was delayed or prevented, causing large losses to farmers. Flooded alfalfa field yielded below average tonnage and in extreme cases stands were killed. Some buildings and wells received minor flood damage. Flood damages inventoried following this flood were adjusted to account for future flood events of the same magnitude and assuming the same reservoir operations. Intensity factors based on this flood were then used to estimate projected flood damages for other frequency events. The one percent chance flood was projected to cause $300,000 damages while the 10 percent chance flood was projected to $8,000 in damages. Average annual flood damages were projected at $9,300.

Chapter III

A G R I C U L T U R A L   W A T E R

Agricultural water problems are related to variations in supply from year to year and during each year, quantity and quality, distribution and conveyance, water application on the farms, and drainage. During the 1956-1965 period, the Basin experienced below normal precipitation which tended to accent normally recurring water shortage problems. Because agriculture provides the primary economic base, changes in available agricultural water can account for similar changes in Basin income.

SUPPLY VARIATIONS

Extreme variations from year to year, as well as between individual months within the year, are characteristic of the Basin's water supply. Annual fluctuations in stream flow vary with precipitation. Ground-water recharge generally shows the same cyclical patterns as streamflows, but use is in excess of recharge and ground-water levels are declining. Ground-water supplies are the main source of irrigation water in some areas and provide supplemental water in other areas. The main source of data for presentation in this section is the Water Budget Analysis Supplement to Appendix II.

TIMING

Most surface water diversions to irrigated cropland are made from streams lacking seasonal regulation. Minersville, Newcastle and Enterprise Reservoirs provide seasonal storage.

Average surface water diversions for 1958-1965 in the Escalante Desert subbasin, which has three reservoirs for regulating water, averaged 7,041 acre feet, with 4,451 acre-feet or 63 percent of total surface water diversions occuring during the peak consumptive use periods of June through August. By contrast, diversions in Fillmore subbasin, which has no reservoirs, averaged 35,546 acre-feet with 9,637 acre-feet of 28 percent of the total diversions occuring during June through August.

Fillmore subbasin surface water diversions during April through June for the 1956-1965 period average 24,580 acre-feet or 68 percent of the total. Most of April through June diversions are not effectively used because of system capacity limitations and a full supply of moisture in the soil profile.

Cedar-Parowan subbasin April-June diversions for 1956 through 1965 averaged 28,294 acre-feet or 69 percent of the annual diverted supply. Some seasonal regulatory storage was available in Yankee Meadow and Red Creek Reservoirs, but this storage did not appreciably affect total spring diversions.

Surface water diversions for the Beaver-Milford subbasin demonstrate the effect of regulatory storage. June through August diversions during the 1956-1965 period for Beaver-Greenville and Manderfield areas averaged 46 percent of the total surface diversions, with 60 percent of the spring diversions occuring during June. By contrast, June through August diversions from Minersville Reservoir totaled 56 percent of the diverted supply, with an even monthly distribution. Average potential consumptive use during the same period was 64 percent of the total.

Pumps were operated during the months of May through October in response to crop needs. Some areas, such as Flowell near Fillmore and Beryl Junction, rely on pumped water as the sole irrigation supply, so the availability of irrigation water depended upon well capacities and legal restraints.

Tabulation summaries from Appendix II, Water Budget Analysis Supplement, have been made of potential consumptive use, root-sone diversion supply, total irrigated cropland root-zone supply and percentage relationship for each month. These tabulations are average values for the 1956-1965 period except as noted and are shown in Table 9.

Most years there was unused root-zone water from November through April when most plants were dormant. Usually there was a deficit in moisture during the growing season (May through October). This is illustrated on the following page in Figure 1.

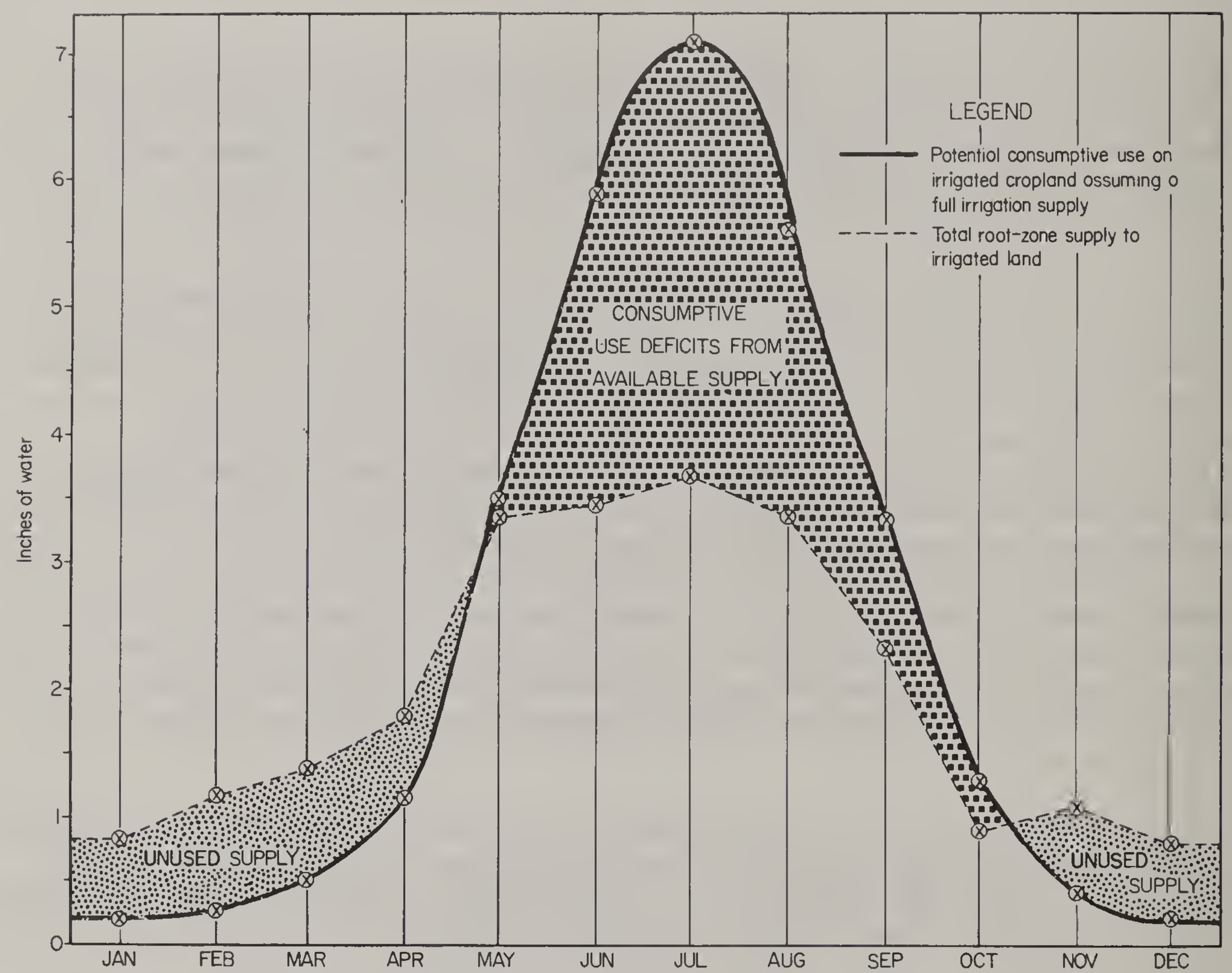

Figure 1 Relationship between monthly total root-zone supply and potential consumptive use, Beaver River Basin.

QUANTITY

Total annual root-zone supply[1] to irrigated cropland for the 1956-1965 period averaged 24.21 inches (Table 9) or 207,760 acre-feet based on 102,979 acres of land which received irrigation water. This compares with a potential consumptive use, assuming a full water supply of 29.41 inches or 252,384 acre-feet.

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[1]Root-sone supply is the amount that is actually supplied to the root-zone by irrigation and precipitation.

TABLE 9.--Average potential consumptive use, root-zone supply from surface water diversions, and total root-zone supply, Beaver River Basin, 1956-1965

Subbasin	Unit	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Fillmore subbasin (2A)														
Potential consumptive use	Percent	1	1	1	5	13	20	23	18	11	5	1	1	100
	Inches	0.22	0.29	1.49	1.53	4.27	6.63	7.65	5.81	3.50	1.76	0.37	0.24	32.76
Supply to the root zone from surface diversions	Percent	3	3	4	14	36	18	6	4	3	3	3	3	100
	Inches	0.13	0.15	0.22	0.74	1.82	0.87	0.29	0.18	0.15	0.14	0.13	0.13	4.95
Total root-zone supply[a] (27,065 acres)	Percent	5	6	8	9	16	13	12	10	8	4	5	4	100
	Inches	1.19	1.62	1.70	2.36	4.04	3.16	2.92	2.61	2.10	1.08	1.23	0.96	24.97
Beaver-Milford subbasin (2B)														
Potential consumptive use	Percent	1	1	2	4	10	20	24	20	12	4	1	1	100
	Inches	0.25	0.30	0.46	1.06	3.39	5.79	7.17	5.89	3.45	1.16	0.41	0.28	29.61
Supply to the root zone from surface diversions	Percent	2	2	3	8	24	24	16	9	5	3	2	2	100
	Inches	0.15	0.15	0.19	0.63	1.85	1.90	1.22	0.74	0.39	0.26	0.17	0.16	7.81
Total root-zone supply[a,b] (27,678 acres)	Percent	3	4	4	7	14	16	17	15	10	4	4	2	100
	Inches	0.80	1.21	1.20	1.84	4.10	4.83	4.91	4.46	2.71	1.32	1.05	0.72	29.15
Cedar-Parowan subbasin (2B1)														
Potential consumptive use	Percent	1	1	1	4	12	21	25	18	11	4	1	1	100
	Inches	0.18	0.27	0.42	1.05	3.49	5.99	7.29	5.36	3.35	1.33	0.35	0.29	29.37
Supply to the root zone from surface diversions	Percent	2	3	4	15	37	17	5	7	4	2	2	2	100
	Inches	0.12	0.14	0.19	0.75	1.89	0.85	0.25	0.35	0.19	0.12	0.12	0.11	5.08
Total root-zone supply[a] (22,299 acres)	Percent	4	5	7	8	15	12	13	14	9	4	5	4	100
	Incbes	0.77	1.15	1.52	1.79	3.16	2.56	2.67	2.94	1.87	0.80	1.01	0.78	21.02
Escalante Desert subbasin (2B2)[c]														
Potential consumptive use	Percent	1	1	1	4	11	20	24	21	12	3	1	1	100
	Inches	0.18	0.23	0.36	0.92	2.90	5.15	6.31	5.60	3.10	0.90	0.27	0.19	25.80
Supply to the root zone from surface diversions	Percent	-	-	1	7	21	19	25	19	5	3	-	-	100
	Inches	-	-	0.01	0.07	0.21	0.19	0.25	0.19	0.05	0.03	-	-	0.99
Total root-zone supply[a] (25,937 acres)	Percent	3	4	5	6	10	14	19	16	12	2	5	4	100
	Inches	0.60	0.77	1.03	1.77	2.16	3.01	3.89	3.37	2.52	0.52	1.07	0.76	20.87
Basin weighted average														
Potential consumptive use	Percent	1	1	1	4	12	20	24	19	12	4	1	1	100
	Inches	0.21	0.27	0.43	1.14	3.52	5.89	7.11	5.60	3.35	1.29	0.35	0.25	29.41
Supply to the root zone from surface diversions[d]	Percent	2	2	3	11	30	21	12	8	4	3	2	2	100
	Inches	0.10	0.11	0.15	0.55	1.47	0.98	0.52	0.38	0.20	0.14	0.11	0.10	4.81
Total root-zone supply[a] (102,979 acres)	Percent	3	5	6	7	14	14	15	14	10	5	4	3	100
	Inches	0.85	1.19	1.37	1.80	3.38	3.44	3.64	3.37	2.32	0.94	1.10	0.81	24.21

[a]Precipitation assumed to be 100 percent effective.
[b]Includes direct use of ground water of 11,871 acre-feet or 5.1 inches.
[c]1958 through 1965 average.
[d]Weighted Basin efficiency of 28 percent.

Source: Beaver River Basin Appendix II, Water Budget Analysis Supplement.

Surplus root-zone supplies occur during January through May from precipitation and irrigation delivery systems. Unused root-zone supply for the years 1956-1965 averaged 16,560 acre feet or 1.9 inches annually. Excess root-zone supply is evaporated, lost through transpiration or percolates to ground water.

Table 10.--Unused root-zone supply for irrigated lands, Beaver River Basin, 1956 - 1965

Water budget area or subbasin	Unused root-zone supply Range	Average
	Acre-feet	Acre-feet
2A-24 Fillmore	0-9,100	3,620
2A-25a Meadow	0-2,530	1,040
2A-25b Kanosh	0-2,890	1,010
2A Fillmore	-	5,670
2B-1 Beaver-Greenville	0-12,310	4,320
2B-2 Manderfield	0-690	200
2B-3,4,6 Minersville-Milford	0-8,230	1,240
2B Beaver-Milford	-	5,760
2B1-1c 2,4 Cedar	0-7,480	2,020
2B1-1a, 3a Summit	0-950	310
2B1-1b, 3b,3c Parowan	0-4,320	1,540
2B1 Cedar-Parowan	-	3,870
2B2-1 Newcastle	0-2,580	1,120
2B2-3 Enterprise	0-360	140
2B2-3 Beryl Junction	-	-
2B2 Escalante Desert	-	1,260
Basin total	-	16,560

Irrigation water lost because of system inefficiencies accounts for 88 percent of the Basin's unused irrigation supply. Total surface diversions averaging 17.2 inches per irrigated acre, provide 4.8 inches of root-zone supply. The remaining 12.4 inches or 106,154 acre-feet is unused supply. The total average supply from well diversions is 21.6 inches per acre irrigated, 8.0 inches of which is the root-zone supply. This leaves 13.6 inches or 116,500 acre-feet unused supply from well diversions. The total surplus from both sources is 26 inches or about 223,000 acre-feet. Only 28 percent of the surface diversions and 37 percent of the well diversions or 33 percent of the total are contributing to root-zone supply.

The 67 percent of the total diversions which are unused represent a considerable expense to the agricultural community. Improve irrigation efficiencies would allow less diversions for the same number of irrigated acres.

Consumptive use deficits in the Basin (as summarized from Appendix II, Water Budget Analysis Supplement) averaged 62,470 acre-feet (7.3 inches) for the 1956-1965 period (Figure 2). This is 32 percent of the approximately 190,000 acre-feet (22.2 inches) of actual consumptive use.

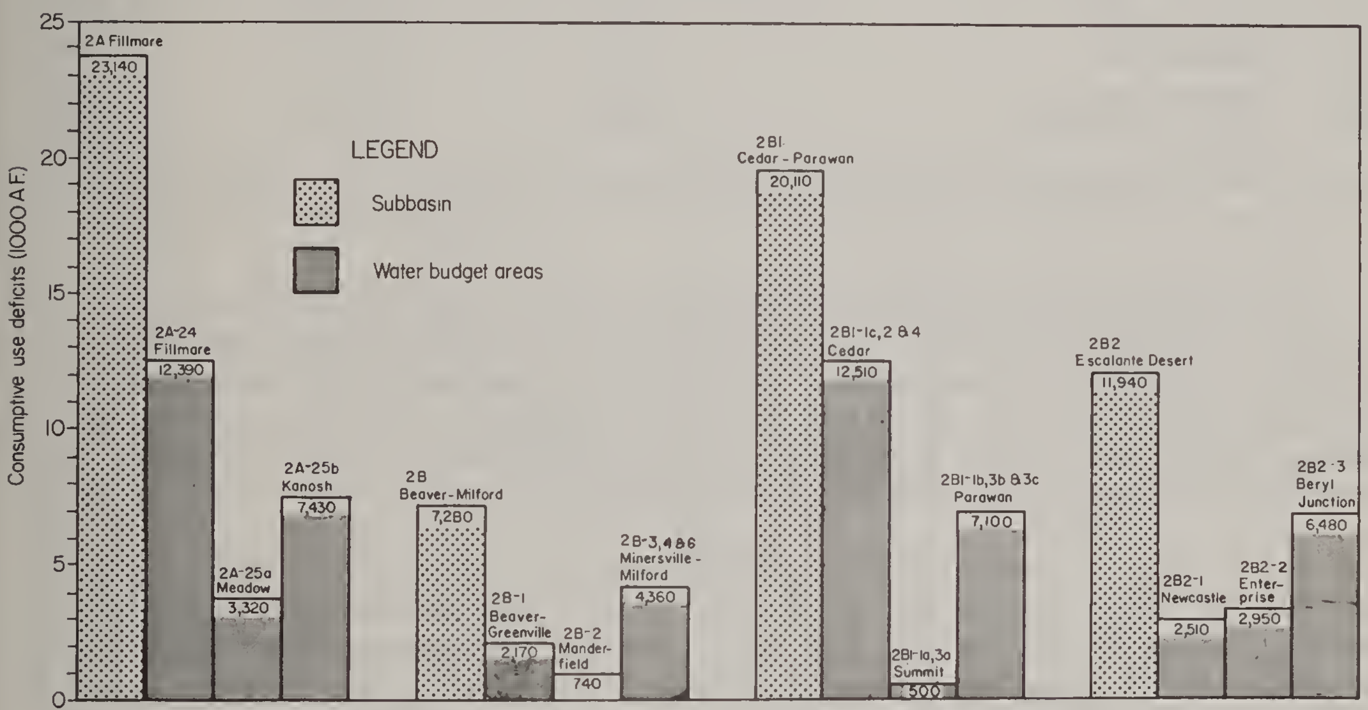

Figure 2. Average consumptive use deficits for water budget areas and subbasins, Beaver River Basin, 1956—1965

SOURCE: Beaver River Basin, Appendix II "Water Budget Analysis Supplement"

Ten water budgets, developed for the years 1956-1965 for each of the twelve water budget areas, were used to develop a frequency of occurence for consumptive use deficits (Table 11). Escalante Desert subbasin water budgets were developed for years 1958-1965. Deficits were tabulated for the 20, 50 and 80 percent chance of occurrence, which represents the maximum deficits that will occur two out of ten, five out of ten and eight out of ten years, respectively

TABLE 11.--Consumptive use deficits by frequency, Beaver River Basin, 1956 - 1965[a]

Water budget area	Percent chance of occurrence 20	50	80
	Acre-feet	Acre-feet	Acre-feet
2A-24 Fillmore	8,900	13,200	18,900
2A-25a Meadow	2,500	3,500	4,800
2A-25b Kanosh	7,000	9,300	11,200
2B-1 Beaver-Greenville	2,180	5,550	9,500
2B-2 Manderfield	325	560	800
2B-3,4,6 Minersville-Milford	1,870	3,550	6,500
2B1-1c,2 and 4 Cedar	9,000	11,800	15,400
2B1-1a,3a Summit	410	740	1,380
2B1-1b,3b,3c Parowan	3,600	6,500	9,800
2B2-1 Newcastle	2,090	2,540	2,130
2B2-2 Enterprise	2,550	3,020	3,480
2B2-3 Beryl Junction	3,450	7,100	10,500

[a]Enterprise 2B2 water budgets were for the 1958 through 1965 period.

Root-zone deficits were due primarily to an inadequate diversion supply to meet the consumptive use demands compounded by the timing of available supply. The BeaverRiver and tributaries above the Minersville Reservoir delivered the most adequate water supply of any area, with average deficits of only 2.2 inches per irrigated acre. In contrast, deficits in the Cedar area averaged nearly 11 inches per acre.

The number of wells and well diversions has increased greatly since the 1940's. Part of the new well development was to overcome seasonal consumptive use deficits and part was to bring additional land into production. As an example, total withdrawal from pumped and flowing wells in the Pavant Valley ground-water basin (includes areas outside the Fillmore subbasin) has increased from 18,000 acre-feet in 1946 to 67,000 acre-feet in 1960. The number of pumped irrigation wells increased from 2 to 110 in the same period.

The large increase in pumping in the Basin has caused a decrease in ground-water levels due to "mining", i.e., the quantity of water pumped is greater than the quantity of water available to recharge the ground-water reservoir. If this trend continues, pumping costs will increase as greater lifts are required to pump the water to the surface.

Beaver-Greenville and Manderfield (2B-1 and 2) were the only areas not showing an average decrease in ground-water storage for the 1956-1965 period. The total average annual decrease in Basin ground-water reservoirs for the ten year period (eight years for Escalante Desert) was 35,990 acre-feet (Table 12). Accumulated decrease in ground-water storage for the same periods totaled 318,800 acre-feet (Figure 3).

Table 12.--Average change in ground-water storage, Beaver River Basin 1956-1965[a]

Ground-water reservoir	Average change in ground water storage
	Acre-feet
Pavant Valley	-11,110
Beaver Valley	+ 2,760
Cedar-Parowan Valley	- 7,080
Escalante Valley[b]	-20,560
Basin total	-35,990

[a]Average for Escalante Valley was for 1958-1965.
[b]Includes Minersville-Milford Watershed.

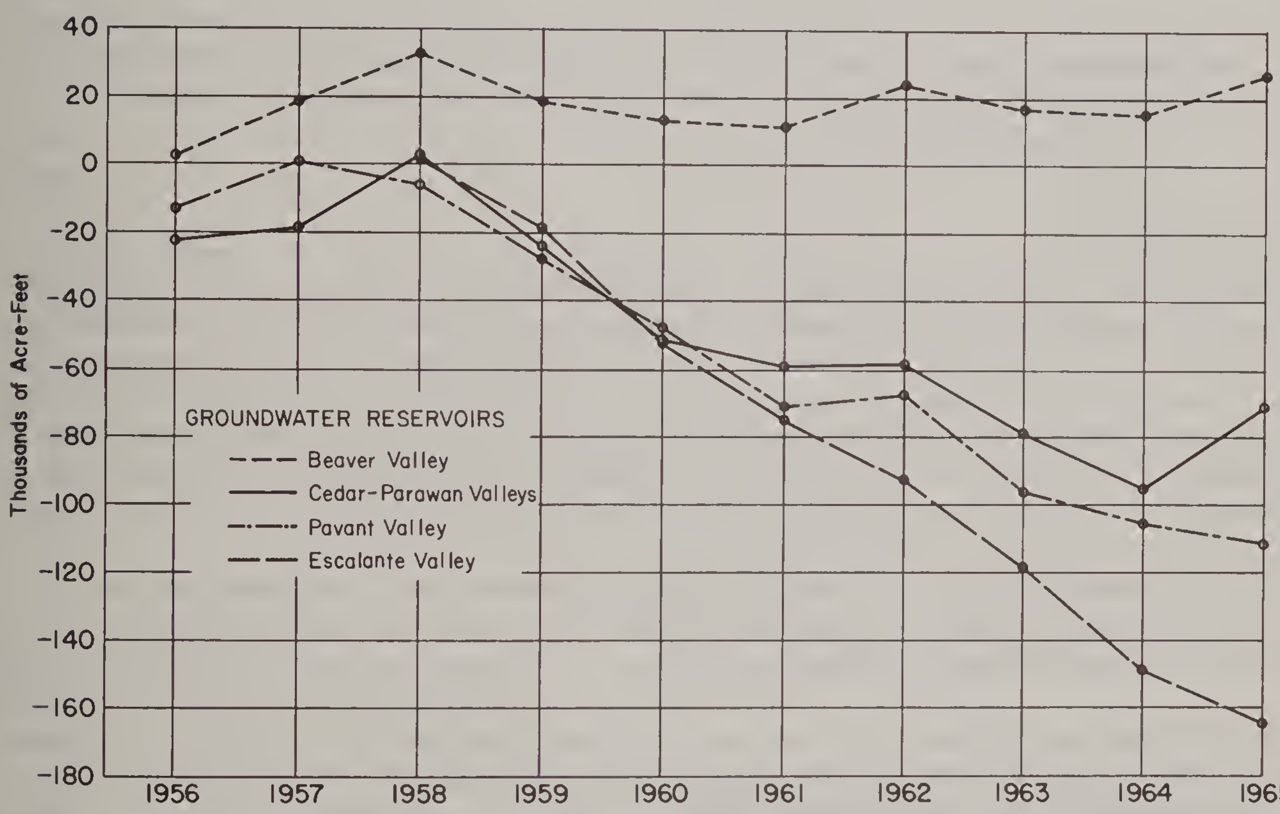

Figure 3. Cumulative change in ground-water storage by ground-water reservoirs. Beaver River Basin, 1956-1965

SOURCE: Beaver River Basin, Appendix II "Water Budget Analysis Supplement"

Decreases in ground-water storage have caused average declines in ground-water levels of 10 to 50 feet during the 1956-1965 study period. The largest declines were in the Escalante Desert and Fillmore subbasin. Declining water levels have increased the cost of well operations, well development and maintenance of existing wells.

Declining ground water levels cause steeper hydraulic gradients from the upper watershed and flatter gradients on the outflow side. Since the majority of the Basin is closed with little ground-water outflow, flattened ground water gradients do not present a serious problem. However, in the Fillmore subbasin, ground-water outflows estimated at 12,000 acre-feet annually, contribute directly to the flow of Clear Lake Springs. Declining water levels in the Fillmore subbasin will affect outflow to this spring. Relationships between declining ground-water levels, well discharge and the flow of Clear Lake Springs have been estimated by the Geological Survey.[1]

DISTRIBUTION AND CONVEYANCE SYSTEMS

Major problems include conveyance losses, inadequate or insufficient structural measures, and company organization and management procedures. Legal and institutional restraints are problems in some locations.

CONVEYANCE LOSSES

Conveyance losses are caused by seepage, evaporation, transpiration by riparian vegetation, and leaks through faulty headgates and burrowing animal holes. The extent of each varies considerably throughout the Basin. Canals in the Meadow water budget area are in good condition with a conveyance efficiency of 90 percent, while those in the Beaver-Greenville water budget area are in poor condition with a conveyance efficiency of 64 percent.

Major losses are due to seepage where canals are constructed on gravelly, permeable soil. Seepage losses vary greatly within irrigation systems and even within a given canal as it passes through different soils.

Transpiration losses are second in magnitude and vary widely between canals. Evaporation losses are higher in canals with low velocities and where larger surface areas are exposed. Generally transpiration losses are also greatest in these flat areas.

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[1] "Causes of Fluctuations in the Rate of Discharge of Clear Lake Springs, Millard County, Utah," W.S.P. 1839-E, U.S. Geological Survey in cooperation with Utah Department of Fish and Game and Utah State Engineer.

Because most canal systems are unimproved, leakage losses are high in some part of nearly every canal. Some leakage occurs in lined sections due to improper installation or insufficient maintenance. Failure and complete interruption of water delivery occur occasionally on some canals due to burrowing animals.

STRUCTURAL MEASURES

Inadequately designed, improperly installed or inefficiently operated water measuring and control structures are a major problem in achieving efficient use and management of water. Most of the diversion dam structures for the main canals are capable of satisfactory service if properly managed. However, several new major structures, along with replacements for old and obsolete structures, are needed. Many minor control structures are also needed for better management.

Most irrigation companies have facilities for measuring water diverted into the main canal. However, most companies either do not have adequate devices for measuring water to individual users or they do not make good use of them.

Surface water supplies vary widely, both seasonally and from year to year. Most surface water runoff occurs when the demand is low. As a result, late season supplies are inadequate. Storage reservoirs in Shoal Creek, Pinto Creek, and Beaver watersheds generally store all available water. Some small storage reservoirs are in use in Beaver, Wildcat Creek, and Red Creek watersheds, but limited capacities prohibit storage of surplus water most of the time. Existing reservoirs are discussed in Appendix II.

Ground-water storage basins provide irrigation water in nearly all watersheds. Some irrigation companies, as well as individual farmers, use water pumped from underground reservoirs to supplement surface water supplies. Lowering water tables and institutional restraints curtail additional use of this supply.

ORGANIZATION AND MANAGEMENT

More than 50 irrigation companies, both incorporated and unincorporated, were studied. Some small unincorporated group and individually owned systems were not studied. Most irrigation companies are small and limited financially, but few have consolidated into larger, more efficient companies. Services and facilities are frequently duplicated, with resulting waste and inefficiency. More efficient operation and maintenance as well as planning, design and construction, could be provided if irrigation companies with overlapping and parallel services and facilities were combined into a single organization.

In many areas, it is common to find miles of parallel canals and laterals a short distance apart. Some land is served by more than one canal or company. Diversion structures are located only a short distance apart on some streams. Water rights and delivery schedules are often interrelated, interdependent, and intricate resulting in complex systems.

WATER APPLICATION

Significant quantities of water are lost by irrigators while applying water to irrigated crops. Principal causes of water loss and inefficient application are poor management, inadequate land treatment, and lack of on-farm structures. Field surveys identified on-farm irrigation efficiencies in 1965. These varied from a low of 37 percent in the Parowan water budget area to a high of 50 percent in the Minersville-Milford water budget area.

Some irrigated land is steep and could be more efficiently irrigated with sprinkler systems. Highly permeable soils are being irrigated with long runs to facilitate equipment usage with a sacrifice of water application efficiency. Improved field layouts, correct lengths of irrigation runs, land leveling, and other practices are needed by many users. Structures essential to proper on-farm water distribution are decidedly lacking.

DRAINAGE

There are 17,800 acres of phreatophyte or non-irrigated "wetlands" in the Basin which receive a full or partial water supply from ground-water reservoirs. Consumptive use on non-irrigated wetlands averaged 25 inches (including precipitation) or 36,520 acre-feet during the base period. Assuming 100 percent consumptive use of 10 inches or 15,040 acre-feet of annual precipitation, wetlands consumptively used 15 inches or 21,480 acre-feet from the ground-water supply during each year.

Most phreatophytic vegetation is valuable for grazing, wildlife, and esthetics. The 21,480 acre-feet consumptively used by phreatophytes could irrigate 5,400 acres at a diversion rate of four acre-feet per acre. However, the wetland areas are quite scattered and cannot readily be treated. Future improvements in irrigation systems and methods will reduce return flows from irrigation, which provide part of the supply to wetlands. Lowering of water tables due to overdrafts of ground water could also reduce consumptive use by phreatophytes.

Natural surface barriers cause some ponding of runoff that results from precipitation. A shallow impermeable soil layer reduces soil infiltration and often holds the ponded water on the surface until it evaporates or is used by vegetation. This occurs mainly in swamp or meadow areas and does not present a problem to irrigated lands.

Chapter IV

LAND USE AND MANAGEMENT PROBLEMS

This section describes problems related to various land uses and management. It includes insects and disease, fire, occupancy problems related to summer home residences and subdivisions and land ownership and access problems.

INSECT AND DISEASE PROBLEMS

Insect and disease problems are described on forest, range and cultivated lands as they affect vegetation. Diseases include those caused by fungi, rusts, cankers, bacteria, and viruses as well as other organisms which affect the physiology of vegetation.

FOREST INSECTS[1]

The mountain pine beetle (Dendroctonus ponderosae) is found in ponderosa pine throughout the Basin area. The western pine beetle (Dendroctonus brevicomis) is especially active on the Pine Valley Mountains. These bark beetles are difficult and expensive to control because each tree must be treated individually.

Defoliators include tent caterpillars (Malacosoma spp.) that affect cottonwood trees as well as many browse species. A blotch miner (phyllanarycter) has caused heavy defoliation of aspen trees in the Chalk Creek and Meadow Creek drainages and can be found on aspen throughout the Basin. Defoliation of pinyon pine in some areas of the Basin is caused by the pinyon needle scale (Matsucoccus acalyptus). Control measures for these pests are not economical because of limited resource values at stake.

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[1] Source: "Forest Insect and Disease Conditions in the Intermountain States during 1969", Forest Service, U.S.D.A., Ogden, Utah

RANGELAND INSECTS[1]

Chewing insects compete with livestock for available forage. Common insects include grasshoppers, Mormon crickets, cutworms, tent caterpillars, leaf miners, and other caterpillars. Insects destroying undesirable shrubs such as rabbitbrush have a beneficial effect on rangeland resources, but these are the exception, and most chewing insects are destructive.

Sucking type insects cause heavy damage to vegetation by removal of sap and plant fluids. Damage from these insects is heavy. Common insects include: aphids, mirid bugs, leafhoppers, false chinch bugs, and stink bugs. Some such as sugar beet leafhopper, spread disease to both crop and certain range plants. This insect is the sole transmitter of the virus of curly-top disease. These leafhoppers can survive through the winter on semi-desert range plants and return the next spring to cultivated lands.

One species of insect, Labobs hesperius, has caused extensive damage on crested wheat reseedings in recent years. There are lygus bugs, blister beetles, and 400 different species of aphids. Nut borers destroy acorns and the seeds of pinyon pine. Small orange dipterous larvae destroy seeds of chokecherry each season over much of Utah. Western harvester ants gather large quantities of grass and other seeds making them unavailable for re-seeding rangelands. Flat-headed and round-headed borers and weevils, a-longwith mealybugs, wire worms, white grubs, billbugs, and sod webworms, cause root injury to many range plants.

CROI LAND INSECTS

A wide variety of insects cause significant crop damage. No attempt is made to identify all of the insects found within the Basin or all damages caused by them. Vegetable gardens and orchards harbor specific insects that cause severe local losses.

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[1] Source: "Much Damage to Ranges Caused by Insects" by George F. Knowlton and Reed S. Roberts. Utah Farmer, May 2, 1968, page 23.

Weevil and aphids cause large losses to alfalfa, the major crop. Adult weevil winter in alfalfa stubble, sagebrush, and weed areas. Large numbers of larvae destroy the alfalfa crops by sucking liquids from the stems and thus depress growth. These insects multiply rapidly and generally damage the first crop more severely than the second or third. Crop damage varies from slight to 50 percent or more of the potential yield.

Aphids multiply very rapidly and small infestations shortly result in large populations. Winged females bear young each place they stop and aphids may spread from alfalfa to other cultivated crops. Potatoes, sugar beets and small grains frequently become infested when large populations are found in alfalfa fields. Effective control of aphids is now difficult because of restrictions on insecticides.

FIRE

About 10 fires (96 in a ten year period) occur each year on National Forests. Examples of past large burns are the Dog Valley fire, which burned 2,405 acres, and the Corn Creek burn of 220 acres. Both of these fires occurred in the Corn Creek watershed. This watershed has a high incidence of fire with 42 fires occurring in the ten-year period. The Shoal Creek watershed has also experienced large fires with about 600 acres within one burn. Recent large fires have occurred in the Beaver watershed and include Sheep Rock, 1,400 acres; Birch Lake, 150 acres; and Baldwin Ridge, 2,200 acres.

Fire occurrence on public domain land includes 10 fires in 1968, 20 in 1969, 10 in 1970 and 6 in 1971. Twelve fires occurred on State and private lands in 1970. This number of fires on State and private land is about average.

SUMMER HOME RESIDENCES AND SUBDIVISIONS

The Beaver River Basin is near enough to Las Vegas, Nevada, and population centers of Southern California that it is desirable as a site for second homes or vacation homes. Retired people seeking solitude and opportunities for quiet living are enticed by the Basin's open space. Forested areas seem more attractive to those seeking vacation homes, and lower areas are more attractive for retirees.

Potential problems begin with the sale of summer home lots without regard to water supply, access, sewage and garbage disposal, fire prevention, or police protection. County administrators are working on these problems.

As these remote areas build up, the cost of providing protection and services will increase. Access roads are commonly surveyed without regard to topography. Many summer home purchasers, as an area develops, may find they have purchased a lot in yet another subdivision with the same problems they were endeavoring to escape. Lack of planning allows the destruction of the very qualities that made these areas desirable home sites in the first place

Liabilities and financial obligations could become serious if potential problems are allowed to develop. Services for garbage and sewage disposal, fire protection and road maintenance will be required. Such services will be difficult and expensive at these dispersed locations.

Lack of zoning controls permits development adjacent to streams that are valuable for public water supply, fishing and enjoyment. Developments are sometimes placed in boggy areas where sewage cannot be disposed of properly. Steep slopes are bisected by roads, and cabins are changing scenic landscapes and vistas.

Resource values destroyed have already been alluded to. They include destruction of esthetic values through construction, contamination of surface and underground water, and improper disposal of garbage and wastes, as well as health hazards related to improper sewage and garbage facilities. Fire hazard increases when cabins and similar developments are placed among flammable forest type vegetation. Erosion and sedimentation problems related to road building, placement of water supplies and foundation excavation also frequently become serious.

LAND OWNERSHIP

The pattern of land ownership is indicated on the land ownership and administration map in Appendix I. State and private lands are scattered throughout public lands. This complex ownership pattern results in many administrative problems and confusion to land users. Laws, rules, and regulations vary for each land category. Unmarked boundaries of these lands lead to unintentional trespass problems. Management in one ownership is often affected by management of other ownerships.

Access to land is a prerequisite to proper management and use. Private owners in some cases are able to restrict the use of public lands by controlling access to them. Acquisition of rights of way to enable full use of public land is part of the program of administering agencies. At times, access is needed across lands administered by one agency to reach lands administered by another.

Coordination among agencies and land owners is also necessary to prevent undesirable disruption of grazing operations. Most livestock graze part of the time on state, National Forest, public domain and private lands. Their operations are geared to a certain schedule and pattern of grazing on each ownership. Disruptions on one class of land may adversely affect an operators use of other lands as well.

Chapter V

ENVIRONMENTAL PROBLEMS

The spectrum of environmental concerns range widely from the impacts on natural resources--air, water, and land--to the impacts on people and esthetic, cultural, and emotional values. Within the broad range of this concept, all problems described in this appendix are "environmental problems". This section addresses itself to additional problems related to the natural environment. These problems are described under three environmental categories: ecology, pollution, and esthetics.

ECOLOGY

The ecology category includes problems related to the relationships of organisms with their environment. This relationship affects species and populations, habitats and communities, and ecosystems. These are the three components of the ecology category.

SPECIES AND POPULATIONS

Three species of animals within the Beaver River Basin are faced with extinction. They are the spotted bat, American peregrine falcon, and prairie falcon. The cause of the decline or rarity of the spotted bat is not known. Pesticides were the major factor in the decline and endangering of the falcons.

Changes in the abundance of many plants and animals have occurred since settlement of the Beaver River Basin. Some species of vegetation once abundant in the desert areas are now limited. Deer populations have increased since settlement, and predators, especially large predators such as bear and mountain lion, have declined. There are environmental problems related to fish populations. Many streams which had abundant native populations at the time of settlement no longer support trout.

HABITATS AND COMMUNITIES

Stable and healthy biotic communities are characterized by a wide variety of plant and animal life. Grazing impacts have changed vegetation on vast areas from communities of a balanced variety of forbs, grasses, and browse to predominantly browse. Revegetation, where browse is removed, frequently establishes a monoculture of crested wheatgrass. Deer are now the dominant wildlife where formerly there was a balanced variety of species. Problems stem from the fact that single dominant species are highly susceptible to variations in their environment. Widespread starvation of deer, declining sage grouse, failure of antelope to increase, and other problems, are related to changes in vegetation. Large populations of a single species are more susceptible to disease.

Habitat for trout has been damaged to the extent that populations can be maintained only through artificial propagation. Natural spawning areas have been destroyed by sedimentation and diversion of stream flow.

Antelope habitat is adversely affected by sheep grazing as both animals compete for forbs. Winter habitat for deer is adversely affected through construction of freeways that destroy habitat and isolate deer by blocking migration routes.

ECOSYSTEMS

Ecosystems denote the interrelationships of nutrients, water, and reproduction among the components of an ecological community. Problems associated with this interrelationship can be illustrated by a sediment laden stream. Muddy water prevents sunlight from reaching the stream bottom, inhibiting the growth of aquatic plants. Insects, in turn, that normally live on aquatic growth and reproduce in water are less abundant. Trout that depend upon these insects for food cannot exist. Any disruption of nutrient energy cycles or hydrologic cycles through changes in water use or management have far reaching affects. Many species will neither nest nor breed because of their sensitivity to man's actions. Disturbances range from noises from airplanes and man's increasing use and occupancy of the land surface, to actual physical damages, such as the damage to pheasant and meadow lark nests when mowing hay and burning ditch banks to deer killed on highways

POLLUTION

Forms of water, air, and land pollution are effecting all segments of the environment. Many pollution problems can be readily controlled, others are more difficult and some may soon become irreversible.

WATER POLLUTION

Water pollution includes those from sediment, dissolved solids (soluable salts), organic substances, temperature, and biological contamination.

Sediment pollution affects most of the surface waters in the Basin. It becomes extremely serious in some streams during periods of rapid snowmelt and during high intensity rainstorms.

Dissolved solids pollute many surface and ground-water supplies of the Basin. Most streams in the mountain areas have a low content of dissolved solids. These concentrations generally increase in the lower reaches of the streams where return flows and seepage waters make up a high proportion of the streamflow volume. For example, a water sample taken from the Beaver River near Beaver on July 13, 1950, showed 75 mg/1 dissolved solids. A sample taken about 8 miles downstream at Adamsville on the same day showed 540 mg/1. The greatest increases in salt concentration occur during periods of low flows and high irrigation diversions.

Ground water varies considerably in salt content from area to area. Published data indicate about 46 percent of the wells have low salinity hazard, 36 percent have medium, 16 percent have high and 2 percent have a very high salinity hazard.[1]

In the Pavant and Escalante Valleys, the concentration of most chemical constituents has increased as ground-water depletions have increased.

Organic and biological pollution includes that caused from waste water, sewage, feedlots, and slaughter houses. Industrial and municipal wastes included in sewage cause problems now and these will continue to increase if solutions are not developed and implemented. Most communities cater to a large tourist trade. In some cases, the sewage treatment facilities designed to dispose of resident population wastes are not able to treat the additional sewage produced by the increased demand.

Fillmore, the second largest city within the Basin, has contracted for a modern central sewage collecting system, part of which has been installed. Beaver City presently dumps raw sewage into the Beaver River. Cedar City sewage is treated by a trickling filter-type installation. Obnoxious odors frequently greet visitors arriving at the airport of this city. Other communities primarily rely on septic tanks to dispose of sewage. Septic tank disposal problems depend on water table levels, location of culinary wells in relation to septic tanks, the number of septic tanks within a given area, and soil characteristics.

AIR POLLUTION

Air pollution consists mainly of particulate dust from the power plant and the mulch plant near Cedar City and open burning throughout the Basin. Other limited pollution, due to solid particles accompanied by temperature inversions, is more of an esthetic problem than a health hazard. Smog, haze, and foul odors, common to most cities, cause some concern.

Radioactive substances such as Strontium 90 are a hazard that needs to be carefully controlled. Small amounts of these substances settle over large areas. As water from rain or melting snow accumulates in streams, these harmful substances are concentrated in streams and ground water supplies.

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[1]Data taken from the State of Utah, Technical Publication No. 10 and Utah Agricultural Experiment Station Bulletin 346, Irrigation Waters of Utah. Low salinity hazard is less than 160 milligrams per liter (mg/l), medium is 160 to 475, high is 475 to 1,450, and very high is greater than 1,450. Calculated from condutivities shown in the U.S. Department of Agriculture Handbook 60, page 80.

Federal and State air quality monitoring stations are located at Milford and Parowan. Stations at Cedar City and Beaver monitor radioactive fallout. Beryllium background sampling was conducted at Cedar City prior to establishing a beryllium facility near Delta in 1970.

GARBAGE AND SOLID WASTE DISPOSAL

Nearly every community within the Basin disposes of garbage and solid wastes by open burning. Many of these sites are adjacent to major highways and cause distractions to visitors. Rats and flies commonly infest garbage dumps and act as vectors for many diseases. Open burning is now prohibited by law except that cities and counties can obtain temporary variance to the law provided they have a plan for installing a sanitary land fill soon. Open burning is thus being phased out.

PESTICIDES AND SPRAYS

The effects of the use of compounds containing cumulative and persistent substances such as mercury, arsenic, dieldrin, and DDT on human life have not been fully evaluated. However, the effects on other organisms in the environment have been well established. Wildlife, especially predatory birds, are diminishing in numbers due to DDT. Hunters are now cautioned about killing pheasants for human consumption because of mercury contamination traced to the use of fungicides on grain.

Other compounds such as hydrocarbons 2-4D or 2-4-5T, and nonpersistent pesticides are less likely to cause direct damage but far reaching ecological changes do result. A certain amount of irrationality due to a lack of knowledge concerning the effects of these substances is now prevalent. The use of pesticides such as 1080 to control predators has been questioned and is now restricted on public lands.

ESTHETICS

Esthetic values are subjective but are generally judged as higher in value the more closely they are in harmony with the natural environment. A summer home built to harmonize with its surroundings, a road that follows the natural features of the land, and a meadering brook in its natural channel generally create pleasing images in the mind. Loss of esthetic values takes place wherever existing beauty is lost or a scene is created which is offensive to the senses.

Scars on the landscape due to road construction, gravel pits, mining, garbage dumps and open burning, and sediment laden and contaminated streams are all examples of esthetic losses.

APPENDIX III

HISTORICAL FLOODS SUPPLEMENT

BEAVER RIVER BASIN, UTAH-NEVADA

Prepared by

United States Department of Agriculture

Economic Research Service - Forest Service - Soil Conservation Service

in cooperation with

Utah State Department of Natural Resources

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APPENDIX III

HISTORICAL FLOODS SUPPLEMENT

BEAVER RIVER BASIN

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INTRODUCTION

This supplement to Appendix III contains the chronology of recorded floods in the Beaver River Basin from about 1853 to 1969. The record of floods listed in this supplement is not complete, but is is felt to be the most comprehensive compilation of past floods written to date. A complete flood record cannot be written because many floods were never documented and have passed from memory. Much of the information was obtained from existing tabulations of floods.

Floods were especially well documented in some localities, but not in others. Some of the probable reasons for this are:

1. Not all communities had a newspaper. Those that did, differed in their attitude toward floods. Many editors and publishers probably did not feel that floods were very newsworthy unless they were large and dramatic, or a life was lost.
2. Floods from canyons issuing onto uncultivated lands were largely ignored. People did not recognize upstream damages from floods. The records of floods, therefore, seem closely related to how settled an area was and whether or not improvements were destroyed. Their actual frequency of occurrence or severity was usually not shown.
3. Weather patterns and watershed conditions varied and there is an actual difference in the number and severity of floods by locality.

SUMMARY

The chronology lists each flood occurrence as it occurs in time starting in the North at Eureka and moving South and West to Shoal Creek. A summary of the data given in the chronology is given in Table 1 and lists date of occurrence, drainage, peak flow, dollar damage, and the source of data.

CHRONOLOGY

Brief excerpts of reported floods are given by drainages or nearby community and include Eureka, Chalk Creek, Meadow Creek, Corn Creek, Wide Mouth Canyon near Kanosh, Beaver River, Milford, Red Creek at Paragonah, Parowan, Summit, Fiddlers Canyon, Dry Canyon, Coal Creek, Pinto Creek, and Shoal Creek.

For each flood, the chronology contains the following information when it is available: Date of flood occurrence, nearest community, stream or drainage, peak flow, and other descriptive notes.

Footnoted numbers in the chronology refer to the sources of flood data listed on page 28. For an individual flood, more than one source of data may have been utilized; peak flow may have been obtained from one source and the notes on the flood from another.

FILLMORE SUBBASIN

EUREKA

(7/14/1896) - The town of Eureka was severely flooded from a torrential rain lasting about one hour. Two individuals were drown in the flood and another died of heart failure. Damages were large which included wrecking of a railroad bridge and tearing out rails. The peak flow was estimated to be 1,000 cfs and caused approximately $68,000 in damages. 1/, 3/ and 12/.

(7/28/1896) - Four people were drown during this flood which was reported as the worst witnessed in the town's history. Main Street, next to the creek, appeared as a raging river until the flood flow dissipated 1/ and 3/.

(2/19/1901) - Heavy rains caused flooding of businesses along Main Street. Floodwaters deposited sediment and debris on the railroad tracks. 1/ and 2/.

(8/25/1903) - Two weeks of heavy rains caused a dam west of town to fail resulting in extensive flooding. 1/ and 2/.

(8/11/1906) - Heavy rains caused flooding within the town. Sewers became clogged and many basements were filled with muddy water. The peak discharge was estimated at 340 cfs which caused an estimated $310 worth of flood damages. 1/, 3/ and 12/

(8/31/1909) - A large mud-flow in the canyon covered the railroad tracks delaying trains for twelve hours. Some coal storage bins were undermined by heavy rains and floodwater. Estimated peak flow associated with this flood was 320 cfs. 1/, 3/, and 12/

(7/22/1910) - A cloudburst generating floodwater filled the McIntyre reservoir with debris and sediment. The reservoir outlet pipe, source of Mammoth City water supply, was covered requiring residents to obtain water from another source until the sediment and debris could be cleared away. Fish stocked in the reservoir were washed over the dam or killed by the muddy water. 1/ and 3/

(7/31/1912) - A heavy rain followed by a cloudburst caused serious flooding. For nearly an hour water two to three feet deep ran down Main Street. Tintic Mercantile store, Wirthin's Meat Market, Finn Saloon, Elite Saloon, and the Heffernan-Thompson storage barn were damaged by floodwater. The peak discharge was estimated at 600 cfs with damages of $23,780. 1/, 3/ and 12/.

(8/26/1912) - Floodwater washed out a section of railroad tracks. The flood peak was estimated at 300 cfs. 1/, 3/ and 12/

(8/7/1915) - Severe electrical storms were followed by excessive rains that caused flooding. Some mine workers at 2,000 feet depths were required to climb out of mine shafts when transmission lines failed. 1/ & 3/

(8/5/1916) - An intensive rainstorm lasting about one hour flooded Main Street and filled many basements with mud and water. 1/ and 3/

(7/23/1918) - Homansville Canyon - The canyon road was completely washed out by a wall of water eight feet deep. 1/ and 3/

(9/1/1919) - Heavy rains, accompanied by electrical storms, damaged streets and utilities extensively. A peak flow of 450 cfs was estimated for this flood with damages of $7,500. 1/, 3/ and 12/

(9/27/1919) - Streets were washed out and bridges and culverts choked with rocks, debris and sediment following heavy rains. 1/ and 3/

(5/25/1921) - A high intensity storm lasting about five minutes caused a flood that washed out streets and damaged property by several thousand dollars. 1/ and 3/

(7/15/1921) - A heavy rainstorm caused flood damage to streets and buildings. 1/ and 3/

(7/23-24/1921) - The main highway and central railroad was severely damaged by floodwater. 3/

(8/29/1921) - Several thousand dollars damage to mining property was reported from recent electrical and rain storms. 1/ and 3/

(8/20/1925) - Homansville Canyon - The canyon road was washed out by a wall of water six feet deep. Damages included scattering railroad ties, rocks and debris throughout the canyon. 1/ and 3/

(7/10/1926) - Eureka Canyon - A rain and hail storm lasting for an hour and a half caused flooding. Three lightning fires started during the storm. Hail accumulated to three inches in depth which may have reduced flood flows. Streets appeared as rivers. Main Street had about two feet depth of water running down it during the peak runoff period. 1/ and 3/

(7/4/1927) - Eureka Canyon - A large culvert near the Rio Grande depot became clogged with debris. A pond developed and floodwater spilled into basements of three adjacent homes causing severe damage. 1/ and 3/.

(9/2/1929) - Eureka Canyon - Heavy rains especially between 11:00 a.m. and 1:30 p.m. caused hundreds of dollars worth of damage. Streets were raging rivers washing sidewalks and road surfaces away. Several downtown businesses as well as some residences were damaged. The peak discharge associated with this flood was estimated at 420 cfs and caused approximately $5,300 damage. 1/,3/and 12/

(8/12/1930) - Eureka Canyon - Floodwater originating in the canyon badly damaged buildings and streets. The Rio Grande and Denver Railroad bridge was washed out and about one-half mile up the canyon several hundred feet of track were washed out. 3/

(7/29/1931) - A wall of water four feet deep washed out two roads and caused damages to streets in Eureka. 1/ and 3/

(7/30/1931) - Eureka Canyon - A high intensity rainstorm yielding 1.09 inches of rain in less than an hour caused extensive damage to roads and buildings. The peak flow was 700 cfs and damages totaled $34,850. 1/, 3/ and 12/

(8/14/1931) - Big Canyon - Eureka and vicinity was struck by cloudbursts. Some roads and railroad structures were badly damaged by floodwater. Cattle and property in the flood path were buried. 1/ and 3/

(8/14/1931) - Eureka Canyon - Streets in Eureka and to the west were severely damaged by floodwater. 1/ and 3/

(7/9/1933) - Streets at Eureka were washed out, windows broken and chimneys blown down by a violent thunderstorm. 1/ and 3/

(8/15/1934) - A high intensity rainstorm resulting in 0.85 inches within 22 minutes caused flooding. A four-foot wall of water swept automobiles down Main Street. Floodwater got into several establishments causing damages. 1/ and 2/

(8/2/1936) - A high intensity thunderstorm produced .90 inch of rain in less than one hour. Streets were badly damaged from the rampaging water. 1/ and 2/

(7/9/1937) - An intense cloudburst damaged streets and earth sidewalks within Eureka. Construction work recently completed by the Works Progress Administration was severely damaged. 1/ and 3/

(8/30/1938) - Homansville Canyon and Eureka Canyon - A thunderstorm damaged roofs with hail and afterward produced raging floodwater. Sections of city streets and canyon roads were washed out. The peak flow was estimated at 500 cfs. Flood damages were inventoried which amounted to nearly $13,000. 1/, 3/ and 12/

CHALK CREEK

(8/1885) - This flood originated in the Lone Pine region at the head of the left-hand fork of Chalk Creek. This flood washed out the dam that supplied the Fillmore flour mill with water power and destroyed the house and belongings of Walter Rowley and his wife. This property was near the creek just below the bridge that was also washed away. 9/

(8/25/1886) - Heavy rains were followed by a terrific flash flood. Bridges and dams across Chalk Creek's main drainage were washed out. One house and all contents were washed away by the flood while still other residents witnessed sediment deposits ranging from two inches to two feet accumulate on their lawns and gardens. Peak flow was estimated to be 1,800 cfs which caused $1,780 worth of damages. 1/, 2/ and 12/

(7/10/1887) - Floodwaters devastated resident property bordering Chalk Creek. Three sawmills were swept away and one-half of a herd of sheep was lost. 1/ and 7/

(7 or 8/1888) - This flood originated in Three Forks, Paradise, White Pine and Bear Canyon and came down the right-hand fork of Chalk Creek. This flood was as devastating as that of 1885 and caused about the same amount of damage. 9/

(7/13/1896) - An enormous body of water swept over portions of Fillmore inundating fields and gardens. Mature trees, drift logs, boulders and sediments were deposited on farms. Main Street was covered with mud knee-deep to a horse for one-half mile. Adjacent homes were surrounded by one to two feet of mud. Several hogs, chickens and cattle were drowned. A Sawmill and some wagons were destroyed. Floodwater carried away 30,000 board feet of lumber. Flood damages were estimated to range between $20,000 and $30,000. The Sevier Lake Watershed report identified damages at $18,910 and to a peak flow of 3,100 cfs. 1/, 2/, and 12/

(8/14/1896) - This flash flood washed out a sawmill and carried trees, boulders and trash into Fillmore. Some mature trees that washed into town had three feet diameters. 1/ and 8/

(7/11/1898) - This flood was composed largely of mud and debris. Ditches became choked with this sediment and debris. Large boulders were swept along by the current as though they were small wood chips. This flood had an estimated peak flow of 1,700 cfs and caused $650 worth of damages. 1/, 8/ and 12/

(8/4/1899) - Raging floodwater carried sediment and debris from the mountains and deposited it on cropland. The flood peak was estimated at 1,600 cfs and caused estimated damages of $580. 1/, 2/ & 12/

(8/24/1913) - The city dam was washed out. A sizeable quantity of driftwood and boulders was brought down with the raging waters. The peak flow was estimated at 1,400 cfs compared to total damages of $440. 1/, 2/ and 12/

(7/27/1917) - The newspaper account describes the flood as the biggest flood in years. Flood damages were estimated at $5,000 stemming from damages to gardens and loss of 12 cows. The channel through which Chalk Creek flows was estimated to be fifteen (15) feet deep at the Highway Bridge on Main Street. The flood overtopped the main channel in many places. A number of very large trees as well as large boulders were washed down with the flood. The Sevier Lake Watershed report shows this flood peak at 2,200 cfs with total damages of $6,470. 1/, 8/ and 12/

(8/25/1922) - Rain showers during a period of several days had produced small floods carrying sediment and debris into town and on irrigated land. This flood was of major size and washed out the Old Fields diversion dam in Chalk Creek. Water was lost and other damages occurred to the system. This event was the third time in succession that the above diversion was washed out. The culinary water system sustained damage necessitating residents to carry water during a twelve hour period. 1/ and 8/

(8/2/1930) - Thousands of tons of rock and sand were spread over the north part of Fillmore and fields west of it. Many basements were filled with floodwater. Many gardens were ruined and deposition was apparent on lawns. The peak flow was estimated at 1,900 cfs compared to damages of $2,910. 1/, 2/ and 12/

(8/23/1933) - A downpour of rain which came with the intensity of a cloudburst caused flooding in Fillmore and vicinity early Sunday morning, tearing down fences, electric light and telephone poles, and laying waste many acres of gardens and farm crops. One of the most damaging streams came down upon the James Swallow farm near Chalk Creek and carried away their garage, chicken coop, drowning 150 young chickens, and covered their cropland with sediment. Chalk Creek overflowed below and above the Highway Bridge and flooded several farms and gardens in its path. Sediment, boulders and debris were deposited on these lands. One home suffered severe flood damage. The flood peak was estimated at 2,100 cfs with flood damages of $5,250. 2/ and 12/

(7/24/1936) - Chalk Creek had intermittent rain during the week which culminated in a major flood on July 24. A dike and concrete masonry diversion wall some six feet high were completely covered with boulders, many of them five and six feet in diameter. Wednesday's flood fairly jarred the town as it thundered off the new CCC flood control dam that had been completed June 12, 1936. The dam did remarkable work in preventing damage from floodwaters below it. This flood nearly filled the 23-foot reservoir behind the flood control structure with sediment. 8/

(7/29/1936) - The largest flood of the year rushed down Chalk Creek routing men who were employed on the W.P.A. project in the canyon. Most of this storm originated in the left-hand fork of the canyon. A Mr. Nichols, CCC Camp engineer at Kanosh, arrived at the flood control dam during this flood and measured the stream going over the spillway at 1,800 cfs. The natural channel of Chalk Creek in the northwest part of town was unable to contain the stream and it flowed down lower Main Street, surrounded houses and covered gardens a foot deep with muddy water. This flood peaked at an estimated 2,400 cfs with a flood damage of $8,980. 8/ and 12/

(8/2/1943) - This flood caused excessive damage to the canyon road and irrigation ditches. The lower fields were damaged by sediment and debris accumulation on irrigated land. The Forest Ranger reported that the canyon road was impassable above the coal mine with large road sections entirely washed away. The peak flow was estimated at 910 cfs with total damages of $140. 8/ and 12/

(8/5/1955) - Major channel damages occurred in Chalk Creek's North and South Forks during the flood. The State Fish and Game personnel on the scene indicated practically all fish in the flood path were either killed or flushed out and restocking would be required before a fish catch could be taken by a fisherman. Several enterprising youths from Fillmore had filled burlap sacks with fish after the flood passed there which supported the State Fish and Game personnel report. The irrigation ditches carried most of the floodwater. Some canal overtopping was noted but only minor damages were observed. The peak flow was estimated at 600 cfs but damages were not identified. 13/

(7/31/1961) - The flood was caused by a thunderstorm centered on the upper reaches of Chalk Creek. White Pine and Bear Canyons supplied the principal flood runoff. When the flood reached Fillmore most of the floodwater was contained in the channel but large logs and other debris plugged it in several places resulting in overland flow and resident damage. Eleven homes were surrounded by floodwater and three basements were filled with floodwater and sediment. Lawns and gardens sustained sediment and debris damages adjacent to flooded homes.

The rainstorm commenced about 1:00 p.m. and the flood crest came through Fillmore at approximately 2:30 p.m. After this peak flow, floodwater gradually reduced in volume during the next two hours.

Approximately four miles of canyon road bordering Chalk Creek sustained flood damage. Some sections were washed out while other road sections sustained light erosion.

The old Chalk Creek channel carried most of the floodwater reducing crop damages substantially. Floodwater diverted into canals caused slight crop damage. This flood peaked at approximately 750 cfs, but flood damages were not identified. 2/, and 13/

(8/7/1963) - Several sections of the culinary pipeline were washed out during the flood. Forest campgrounds adjacent to Chalk Creek were severely damaged. Two couples were stranded at the campgrounds for a period of time while roads were being repaird. 2/

MEADOW CREEK

(7/14/1896) - Many acres of growing crops were covered and destroyed by mud and water. Haystacks and farm buildings within the flood path were swept away by the raging water. The peak flow was estimated at 1,200 cfs with total flood damages of $4,010. 1/, 2/ and 12/

(8/4/1916) - A large flood containing rocks, debris and sediment spread out over the town. Cultivated fields were covered with tons of debris and sediment destroying many crops in the flood path. This flood was reported as the largest since 1896. The flood damage was estimated at $3,180 with a peak flow of 1,000 cfs. 1/, 2/ and 12/

(7/21/1934) - The Desert News account merely states that Holden, Lynndyl and Meadow received flood damages. The Sevier Lake Watershed report shows the peak flow at 800 cfs and total flood damages of $2,350. 1/, 2/ and 12/

CORN CREEK

(7/13/1896) - Crops in the flood path were destroyed by mud and water. Some haystacks and farm buildings were swept away. The flood was reported to have peaked at 1,650 cfs and caused $6,900 in damages. 1/, 2/ and 12/

(8/25/1905) - City streets were flooded leaving behind a mass of mud and rocks. Gardens, lawns and fields within the flood path were covered with sediment and debris about twelve inches deep. 1/ and 2/

(8/4/1916) - Corn Creek and other drainages east of Kanosh produced floodwater. Streets were flooded and basements filled with sediment. Gardens, lawns, alfalfa and other crops suffered severe damage. 1/ & 2/

(8/19/1934) - Trenches prepared to have culinary water pipes placed in them were filled with sediment and debris. The peak flow was estimated at 900 cfs with $2,130 in flood damages. 1/, 2/ and 12/

(8/15/1936) - A flood late in the afternoon washed out a bridge and seventy-five feet of the main highway. 1/ and 2/

(7/16/1965) - This storm was a heavy cloudburst and occurred at about 3:00 p.m. A heavy downpour lasted for about one and one-half hours. Floodwater accumulated in two small drainages, Big Hollow and Trail Springs, and peaked at 1,350 cfs at the USGS crest staff gage. Soil Conservation Service personnel measured the flow downstream at 688 cfs. The sediment pond east of Kanosh contained the peak discharge and provided a regulation device so that two concrete canals were able to carry off the floodwater.

A thin layer of sediment was deposited on 400 acres of cropland, some of which was being irrigated at the time, and caused minor damages. Some streambank erosion occurred above the sediment pond but noticeable damages were low. Considerable land scouring and some minor gullying on the Big Hollow and Trail Springs drainages resulted in a large amount of sediment being washed down the canyon. These drainages had been heavily grazed and ground cover was sparse.

Glenn Quigley, from the Forest Service, collected water samples below the sedimentation pond. About 40 percent of the total volume was estimated to be sediment. Quantities of debris and sediment were deposited above the principle spillway outlet. 13/

WIDE MOUTH CANYON NEAR KANOSH

(8/11/1961) - Floodwater ran for approximately one hour. The high intensity thunderstorm causing this flood flow lasted for about one-half hour and caused an estimated peak flow of 75 cfs. Gullying was noticeable on dry cropland. 13/

(8/19/1963) - An intensive cloudburst yielding rain and hail occurred about 3:00 p.m. The storm center moved in a northeast direction through Baker Canyon, along the foothills, grazing lands, and fallow fields. The flood flow from this intense storm peaked at 2,000 cfs. Traffic using U. S. Highway 91 was stopped for several hours.

A 60-inch culvert carried the initial flood flow but eventually became plugged with debris and sediment. Highway Department personnel reported seeing a large flood flow traveling about 6-10 feet per second flowing over a low section of the highway. A storage pond above the road washed out and released floodwater and trapped sediment.

Road damages were estimated at $5,000. Highway personnel also mentioned the possibility of placing a larger culvert or box under the highway. This would cost an additional $5,000.

Three storage ponds were damaged or destroyed when floodwater inflow exceeded the spillway capacity. Water overtopping these dams eventually caused them to fail.

The area immediately above U. S. Highway 91 could not contain the intense rainfall. Heavy grazing practiced on range and dry pasture land had depleted plant cover so that much of this area was essentially bare ground. Some cropland had been plowed previously in preparation to fall seeding of winter wheat.

Not much damage was done to this area other than some minor gullying and land scour. This may be because the soil was fairly moist from a rainstorm the week before. The area flooded was rangeland west of the farming area and floodwater resembled a good irrigation instead of a damaging act of nature. 13/

(8/17/1965) - This flood was caused by an intensive cloudburst which moved in a northeast direction through Baker and Wide Mouth Canyon covering mostly the upper watershed. Lesser amounts fell on the lower foothills, grazing lands, and fallowed areas. It occurred between 2:30 and 4:00 p.m. with the major part falling during the first one-half to three-quarters of an hour.

The flood started about 3:00 p.m. and continued until nearly 7:00 p.m. The peak flow was estimated at 1,800 cfs. The 60 inch culvert under U. S. Highway 91 carried the flood flow until it became plugged with debris and sediment. A storage pond broke during the flood. The water stored in the pond, flooded grazing land below it.

Most damage was to the shoulder of U. S. Highway 91. Water running over the top of the road caused considerable cutting and washing.

Not much damage was caused to cropland and rangeland above or below U. S. Highway 91. Soils were wet from daily storms that had occurred for several days prior to this storm. Some jeep roads in the upper watershed were damaged. A cattle loading chute was damaged. 13/

BEAVER-MILFORD SUBBASIN

BEAVER RIVER

(8/4/1873) - Heavy rain caused flooding through city streets and did some hay and crop damage. 1/ and 11/

(8/7/1882) - A series of flood peaks over eight feet deep came down the canyon. Mumford farm was almost entirely ruined. Brick kilns containing about 100,000 bricks were partially washed away and collapsed. 1/

(8/15/1901) - A large flood originating in the upper watershed deposited rocks and mud on irrigated fields. A lot of shocked grain was washed away.

Adamsville, nine miles west of Beaver, was similarly flooded and damage to crops was very severe. The estimated flood peak was 1,950 cfs and caused $39,840 damage. 1/, 2/ and 12/

(9/2/1935) - A high intensity cloudburst resulted in major watershed runoff. Boulders, debris and sediment were deposited across the highway for several miles. The Beaver City Power Company canal was filled with sediment and debris disrupting this power source. Residents were without electrical power for some time. 1/ and 2/

(8/16/1936) - A severe hail and rainstorm resulted in 1.56 inches of precipitation in an hour. Hail five to six inches deep destroyed crops. 1/, 2/

(9/4/1937) - Severe rainstorms caused flooding to lands adjacent to Beaver River. The main highway was closed for several hours while maintenance crews removed debris and replaced road fill. 1/, 2/

(1969) - High water table damage occurred at Beaver during the spring of 1969. Many basements had water in them. Some homes used sump pumps which had not been used for several years. Basement furniture, carpets, walls and other items were damaged by the rising water table before sump pumps could be employed to pump it out. An inventory of estimated damages totaled $3,000.

MILFORD

(7/26/1916) - A cloudburst nine miles southeast of town caused extensive flood damage. Ranches were temporarily abandoned to escape the flood. Roads were washed out and ranch lands flooded. 1/ and 2/

(8/4/1929) - One of the worst storms to hit Milford caused extensive flooding. Floodwater reached depths of 13 inches along Main Street. Businesses along Main Street had much merchandise damaged. 1/ and 2/

(7/4/1934) - The heaviest rain since 1929 caused widespread flooding at Milford. Floodwaters washed out streets and gardens and filled basements with mud. 1/ and 2/

(7/9/1936) - A cloudburst occurred at Frisco Canyon above Milford. Large streams gushed down from the side washes flooding the south end of Milford. 1/ and 2/

CEDAR-PAROWAN SUBBASIN

RED CREEK AT PARAGONAH

(8/6/1901) - This large flood transported large trees and boulders onto cropland causing severe damage to crops. 1/ and 2/

(8/14/1901) - Small grain and alfalfa fields within the flood path were damaged by sediment and debris. 1/ and 2/

PAROWAN

(8/31/1857) - All bridges for 7 miles up the canyon were washed out during this flood. The sawmill dam, Ox-frame dam on Cricket Fork, and the Gristmill dam were washed out. Debris and sediment were deposited on cropland adjacent to the city. 1/ and 2/

(7/20/1874) - Portions of Parowan community were flooded as raging water in Center Creek over-topped its banks. Several bridges and dams across Center Creek were washed out. 1/ and 10/

(7/27/1906) - The largest flood in 10 years came down the canyon depositing sediment and debris on lands within its path. The debris included several sheep and cattle as well as one horse. One fellow was nearly drowned while attempting to cross Center Creek during flood stage. 1/ and 2/

(7/10-21/1914) - Continued intermittent rains caused flooding along Center Street. 1/ and 14/

(8/2,5,6/1963) - The principal flood occurred on August 2, 1963, beginning about 4:00 p.m. after a cloudburst fell on the lower part of Parowan Canyon which included Dry Canyon and about three miles up First Left Hand Fork. Flood flows on the 5th and 6th originated in approximately the same area as the previous flood but of much less magnitude with an estimated peak of 100 cfs. These flows caused minor damages. Floodwater originated on lands other than those grazed by domestic livestock. Principal uses included watershed, recreation and deer habitat.

Parowan's culinary pipeline was damaged during the flood. Actual damages cannot be accurately evaluated until repair work is complete. It may be that the flood opened up the spring area so much that it may be permanently contaminated. If this is the case, the spring would have to be abandoned and another source of water developed which might cost as much as $50,000. 13/

(7/13/1967) - Floodwater originated in the foothills beginning at the old flour mill and extended to include Dry Creek. Apparently the flood occurred during the afternoon. Considerable damage was sustained by crops in the flood path. A large volume of debris and sediment was deposited along Highway 91 right-of-way. The resulting condition was very unsightly. Peak flow was estimated to be 620 cfs but no flood damages were identified. 13/

(7/22/1968) - A small flood occurred July 22, 1968 beginning at 1:30 p.m. and continued until 6:30 p.m. The peak flow estimated at 350 cfs was noted at approximately 2:30 p.m. The flow carried a large portion of sediment but no measurements were made even though a water sample was taken.

Several diversions along Center Creek were diverting a maximum flow. Fine sediments were being distributed throughout the irrigation systems and eventually being deposited on irrigated land. The high sediment load caused damages to the Parowan City Power Plant. 13/

SUMMIT

(7/20/1874) - Large boulders were deposited on city streets along with sediment and other debris. 1/ and 10/

FIDDLERS CANYON

This drainage has produced flash floods in the past. Some references are included with reported floods on Coal Creek since both drainages generally flood at the same time.

DRY CANYON

(8/19/1965) - The city golf course, cemetery and Bureau of Land Management repair shop were damaged by a flash flood following an intense rainstorm. A wall of water about 4 feet deep struck this area. One car was turned over while another was washed off the road. The north end of the cemetery was inundated. Sediment and debris was scattered about. A 40-foot section of the cemetery's east rock wall was toppled by floodwater. Considerable damage occurred to Bureau of Land Management buildings and equipment. Actual damage was not estimated but 10 tons of grass seed and 1,500 cedar posts were washed away or badly damaged. Damage to the golf course was estimated at $5,000 while the city cemetery damage was estimated at $500.

COAL CREEK

(9/3/1853) - This flood carried away bridges and dams in its path. A large quantity of logs and huge rocks were carried along with the raging water and considerable damage was done to the iron works. 1/ and 2/

(7/25/1870) - Streets and basements were flooded; bridges, fences and ditches were washed out or damaged. 1/ and 2/

(8/19/1886) - A hail-rainstorm caused a flood that flooded basements, gullied farm land, and carried away wheat sheaves. The flood peak was estimated at 1,800 cfs. 1/, 11/, and 12/

(8/10/1901) - Roaring floodwater carried gravel and other debris down the canyon. This flood was reported to have a peak discharge of 1,500 cfs. 1/, 2/ and 12/

(7/22/1904) - Cedar City was damaged by the largest reported flood in 36 years. The major flow came from Coal Creek and the remainder came from Fiddlers Canyon. Parts of town were flooded. Damages occurred to barns, hogpens, chicken coops, and crops. Diversion dams were washed out and ditches filled with mud. The flood peak was estimated at 2,450 cfs with damages of $33,620. 1/, 2/ and 12/

(8/12/1907) - A large flash flood filled city streets with mud and water. 1/ and 2/

(8/21/1907) - Water poured into town about 2 feet or more in depth, streets and basements were flooded, fields were covered with debris and sediment and many crops were destroyed. More damage was reported from this flood than from the one on August 12th. The peak discharge was estimated at 3,650 cfs with estimated damages of $134,220. 1/, 2/ and 12/

(8/20/1909) - Intensive rain caused floodwater east of town along the foothills. Concerted efforts by residents kept floodwater out of basements. Only Minor damage was sustained. 1/ and 2/

(9/29-30/1909) - Heavy rainstorms caused flooding everywhere. Bridges were washed out, roads obliterated, and gullies made where before were good wagon roads. 1/ and 2/

(9/29/1909) - A heavy flood came from the mountain area east of Union Fields doing considerable damage to corn, potatoes, and alfalfa. 1/ and 2/

(7/25/1915) - A heavy storm hit the mountains east of Cedar City. The flood that followed washed out road, bridges, flumes and dams. The grist mill was put out of commission. The canyon road was left impassable. Peak discharge was estimated at 3,200 cfs with flood damages of approximately $90,000. 1/, 2/ and 12/

(8/2/1920) - A storm in Cedar Canyon washed out part of the Cedar Canyon road. Road damage was estimated at $3,000. The flood also cut out part of a bridge and cut a channel around the irrigation dam north of the city limits. Two men were trying to save a culvert that was about to be washed away. Part of the road where they were working caved into the stream and one man was carried 300 feet downstream. Peak discharge was estimated at 1,190 cfs which caused an estimated damage of $360. 5/ and 12/

(8/20/1921) - Houses were damaged, basements flooded, ground floors of flooded homes had water depths of a few inches to 4 or 5 feet. Cattle, pigs, chickens were drowned. Bridges were washed away and crops were damaged. Damages were estimated at more than $20,000. Boulders and mud covered farm lands and part of the town. This flood was estimated to have a peak discharge of 4,000 cfs with $168,810 worth of damages. 1/, 2/ & 12/

(7/22/1921) - A flood at Summit canyon inundated the town of Summit destroyed nearly all gardens and depositing tons of debris in the town. The flood also reached cropland below the town. Similar conditions were experienced on Coal Creek. The flood was large and very devastating with a peak of 4,500 cfs which caused an estimated $217,900 damages to property along Coal Creek. 5/

(8/13/1930) - A flood delayed highway traffic two hours at a point 3 miles north of Cedar City. 5/

(7/30/1931) - A flood followed a heavy rain recorded at 1.2 inches. The day before, .57 inches of rain had been recorded. Portions of Parowan-Cedar City road was badly eroded. The flood peak was estimated at 850 cfs which caused about $200 damages. 2/, 5/ and 12/

(7/9/1936) - Streets were flooded about 1 foot deep. Basements were filled with floodwater. Traffic on all highways within 50 miles was stopped. The flood peak discharge was estimated at 2,910 cfs with damages of about $61,000. 2/ 5/ and 12/

(7/11/1936) - Another large flood damaged Cedar City property following the third successive day of heavy rains. Much of Cedar City was covered with red mud from floodwater. The peak flow was estimated at 1,700 cfs with an estimated $6,000 damages. 2/, 5/ and 12/

(8/30/1938) - Streets and basements were flooded in Iron County. U. S. Highway 91, between Kanarraville and Parowna, was flooded with mud and water. This flood was estimated to have a peak discharge of 1,500 cfs and caused approximately $1,900 damages. 5/ and 12/

(7/14/1953) - At about 9:30 p.m. a flood came down Coal Creek. From reports of old-time residents, it was believed the largest in 20 years. The storm came from the area below the crest of Cedar Breaks. The rain guage at the Lodge showed only .01 of an inch being recorded. From measurements taken at the Woodbury dividing structure, northwest of Cedar City, the peak discharge was about 2,000 cfs.

The damage was caused by the large amount of debris carried; several individuals estimated the flow at 50 percent sediment. This sediment covered several farms with thick yellow clay from 2 to 6 inches deep. It also filled many irrigation ditches with clay and rubbish.

Many boulders 4 to 5 feet in diameter were rolled down the creek, and left on the delta below Cedar City. The 3/8 inch steel dividers were torn from the structures built in 1952. Culverts under the Union Pacific Railroad were clogged with logs and debris, as also were many splits and bridges causing much damage to farm lands. Pictures were taken of the main damage areas and are available for reference. 4/

(7/26/1956) - Cloudburst on Cedar Mountain struck at noon July 26 and caused thousands of dollars damage to homes in northwest part of Cedar City. The flood centered at 1150 west but spread from 700 West to 1250 West. Homes were surrounded by water two feet deep which poured into basements damaging homes and furnishings, yards and roads. The flood swept the whole city mainly concentrated in the southwest which drained to the northwest. Housing projects in the developed area were flooded. The main force of the flood poured out of the channel through farm lands across Center Street at 1050-1150 Main Street. 5/

(8/2/1956) - The flood on July 26 was one of three succeeding floods caused by rain on northern slope of Cedar Mountain. Because of the efforts of the residents the second and third floods were not as devastating.

The second flood came on July 28. It crossed Highway 91. Citizens pooled their efforts to construct a diversion dam before the flood arrived. They took other measures to spread the water over the fields before it got to the homes. They dug a diversion ditch to carry the water past the residential area.

At 8:00 a.m., July 29, another storm hit. The flood was second largest but the water was carried off with no damage and was diverted to a sagebrush field. 5/

(8/2/1959) - This rainstorm centered on the headquarters of Coal Creek within the Cedar Breaks area. The rain gage located at Cedar Breaks National Monument headquarters showed 0.14 inches for the 24-hour period ending late Sunday afternoon (about 4:30 p.m.). The main storm clouds were observed north of the headquarters. Cedar City residents were notified by Park Rangers that a flash flood was forming, following an intense rainstorm.

The peak runoff estimated at 1,200 cfs (including sediment and debris) hit Ashdown Creek USGS gage about 5:00 p.m. The gage intake pipes were plugged with fine sediment during the flood; therefore, the recording did not show the receding part of the hydrograph. At the lower debris basin (at the power plant) the maximum depth of flow over the 60-foot wide spillway crest was estimated at 1.5 feet resulting in approximately 390 cfs.

Irrigation inlets below the power plant were locked open and local officials were not able to close them before the flood arrived. Consequently, the canals and main laterals carried and distributed the red, silty floodwater over a wide area. Considerable floodwater ran through many ditches and gutters throughout Cedar City Sunday evening. Many of the city ditches, gutters, and irrigation culverts and structures clogged with trash, weeds, sediment, and other obstructions, forcing the floodwater over lawns, gardens, sidewalks, and streets. The two floodwater samples collected Sunday evening at the U. S. Highway bridge, by Tom Evans, contained 75 and 86 percent suspended sediment (by weight).

In the irrigated areas north and west of Cedar City, debris and sediment caused many road culverts and irrigation structures to clog and lose considerable or all of their capacity. There was considerable deposition of fine sediments in low areas, natural channels, borrowpits, canals, ditches, culverts, and irrigation structures. In addition, there were many spots in the fields where the overflow left deposits of sediment two to three inches deep. In a few locations, there was enough deposition of red mud on the road to make vehicle travel vary hazardous or temporarily impossible.

An estimated 60 acres of irrigated hay, cropland or gardens received noticeable sediment depostition. Floodwater inundated an estimated 160 acres. Red mud deposition from this flood was observed in Cedar Valley as far as six miles northwest of Cedar City. Residents remarked that this flood carried an unusually high load of fine, red sediment. They said that when the irrigated fields received about 6 inches of this type of deposition, they were usually unfit for further cultivation. Several local fields were pointed out as having gone out of cultivation due to past deposition of fine sediments. Damages were estimated at $7,800. 12/ and 13/

(8/3/1959) - The inital flood crest reached the county bridge near Milt's Stage-Stop Inn at 6:43 p.m. The flood peak was observed about three minutes after the front arrived. A height of 2.2 feet was observed on the newly installed USGS "crest-stage" installation, on the upstream side of this bridge opening. There was considerable debris in the forward portion of the flood - large logs, trees, old power poles, a 30 foot bridge, and old sawmill lumber scraps. Pictures were taken, but turned out poor, as it was late and very overcast.

The flood crest arrived at the lower debris basin spillway (by the power plant) at 7:24 p.m. The average velocity for the above 3.2 mile reach was determined to be approximately 7 feet per second (bed-slope of the channel ranges from 1.4 to 3.0 percent through this section with two bridge openings and two debris basins in it). Estimated maximum depth of flow over the lower debris basin spillway was three feet. The majority of the large boulders (exceeding 1.0 feet in diameter) and some of the larger, heavy logs were deposited in the debris basins. Both debris basins have no remaining storage capacity below spillway crest. However, it was

evident that the debris basins are still effective in trapping out the coarse, heavier sediments and debris. They also help by retarding and reducing peak flows. The reduction in the amount of large debris carried by the flood is very important, as this can readily plug bridge and culvert openings and cause further deposition of sediment in the channels.

The flood flow stayed within Coal Creek channel as it proceeded through town. The main flow arrived at the concrete irrigation diversion and splitter structure at 7:53 p.m. Here the flow exceeded the capacity of the lined concrete section and there was some channel scouring downstream.

A portion of the flood, carrying considerable trash and debris, blocked the four-barrel culvert under the main Union Pacific tracks at the junction of U-19 and U-56. Since these culverts were partially filled with fine sediment from Sunday evening's flood, debris quickly plugged the culvert openings, despite efforts of the section-crew in removing it. Afterward the water flooded portions of an adjacent hayfield and also ran over Highway U-19. The flood was estimated to be 175 cfs at 9:00 p.m. and 120 cfs at 10:00 p.m. at the main U.S. Highway 91 bridge in Cedar City.

Sediment samples were taken by Bridges and Judd just below the power plant. Time of sampling, date and percent sediment by weight were as follows: 7:30 p.m., 8/3, 45 and 48 percent; 9:30 a.m., 8/4, 0.7 percent. Ramsay collected a water sample in town, at the U-14 highway bridge, at 7:35 p.m., 8/3, which ran 44 percent sediment; Carlson also took a sample at the U.S. 91 highway bridge at 11:00 p.m., 8/3, which ran 30 percent.

At the Ashdown gage site, Mr. McConkie from USGS stated that the channel cross-section had changed considerably since he had made his last measurement about 10 days before. Below the gage, it was observed that the channel had been scoured four to five feet deeper in some sections than when it was last seen. Above the mouth of Blowhard Hollow, the main Ashdown channel had been scoured considerably and bank-cutting was evident in many places. At the mouth of Spring Creek, site of an old sawmill, there was considerable recent deposition of fine sediment. Several of these deposits appeared to have been mud flows, which stopped with a steep slope on the forward edge of the flow.

Ramsay and Gerry surveyed several channel cross-sections on Coal Creek, just below the highway U-14 bridge (in town). On the basis of this slope-area measurement, the peak flow at the bridge, August 3, was approximately 900 cfs.

The greatest damage was caused by the deposition of debris and fine sediment in the irrigation systems. Damages to farmland, crops, roads, bridges, and culverts were also observed in many locations. In Cedar City (8/2/1959) some of the streets, gutters, culverts, and low areas were flooded by excess water from the irrigation ditches, resulting in considerable deposition of fine, red sediment. The municipal power plant also suffered damage to its facilities on Coal Creek.

Hay, especially that already cut and lying on the ground, was badly damaged by the sediment laden floodwater. The uncut hayfields also incurred damages as haying operations had to be postponed until the mud deposits dried. It was necessary to wait until the mud dried somewhat before it could be cleaned from ditches. This delay caused reduced yields on those fields needing irrigation water at the time of the flood.

The sediment was deposited unevenly causing ridges, which necessitates grading and floating or releveling before the fields can be irrigated properly.

An estimated 100 acres of irrigated cropland, hayland, tame pasture, and gardents received noticeable deposits of fine, red sediment. The total valley area covered by floodwater from these two floods is estimated at 240 acres.

Black and white photographs and color slides were taken which show debris and sediment deposition in ditches, canals, and irrigation structures; floodwater and deposition on cropland and hayfields; deposition and debris on roads and streets, and in culvert and bridge openings; and deposition and bank-cutting in natural channels. Estimated damages are as follows from Coal Creek floods August 2-3, 1959:

Cedar City streets and ditches	$ 500
State of Utah Highway Department	500
Union Pacific Railroad Company	1,000
South & West Fields Irrigation Co.	300
Coal Creek Irrigation Company	800
North Fields Irrigation Company	300
Iron County Roads	400
Damage to crops	1,000
Damage to farmland (200 acres)	3,000
Total	7,800 6/

(8/3/1961) - Flood damages were reported for cropland and roads, bridges and railroads amounting to $1,800 and $2,500, respectively. Total flood damages were estimated at $4,300. 13/

(8/10/1961) - This flood inundated 5 acres of barley and alfalfa resulting in an estimated loss of $400. Roads, bridges and railroad damages were estimated at $1,100. 13/

(8/20/1961-8/21/1961-8/22/1961) - Three small flash flood occurring on succeeding days caused minor damages. Total damages were estimated to be $400, $300 and $650, respectively. 13/

(9/8/1961) - Thirty acres of cropland were flooded causing $600 in damages. Two miles of irrigation system had flood damages estimated at $600. Damages sustained by roads and bridges were estimated at $600 resulting in a total damage loss of $1,800. The peak discharge was computed at 225 cfs. 6/

(9/8/1961) - One inch of rain came in 10 hours. About 20 cfs flow was diverted through Greens Lake flood channel.

Excess water caused a small landslide 1 mile east of Cedar City. Boulders as large as a car were strewn over Highway 14. Telephone lines between Cedar and Kanab-Glen Canyon area were taken out. Several photos were taken of the damages that occurred. 5/

(9/17/1961) - A flash flood inundated 15 acres of cropland resulting in $450 damages. Road and bridge damage was estimated at $200. Irrigation systems damage was estimated at $100 for a total of $750. The peak discharge was estimated at 300 cfs. 13/

(8/13/1964) - A flash flood originating in the upper reaches of Coal Creek caused minor damages. Floodwater inundated 50 acres of alfalfa causing an estimated $3,000 in land damage. Sediment and debris removal was estimated at $3,000. Six miles of damaged canal system would require $2,000 to rehabilitate. Roads, bridges and railroad damages were estimated at $1,000 resulting in a gross damage of $9,000. This flood had a peak discharge of approximately 830 cfs. 13/

(8/17/1965) - Flood damages were identified below confluence of Salt Creek and Coal Creek. Flow measurments were made in both contributing streams. Coal Creek peak flow was measured at 1,530 cfs while Salt Creek flow was measured at 1,500 cfs indicating that the bulk of the floodwater originated in Salt Creek. A total of 1,750 acres of cropland was flooded resulting in $23,540 damages. About 600 acres of alfalfa and 450 acres of barley were flooded. Severe soil damage occurred on an additional 200 acres of cropland. Five irrigation systems suffered damage of $500 and 25 rods of fence was damaged with losses of $40. Roads and bridges suffered $1,000 worth of damages. Total flood damages were estimated at about $25,000. 13/

(7/16/1967) - Flood damages to highways consisted of damage to culverts, road shoulders, and bridges. Maple Canyon bridge was heaviest hit just above Milt's State Coach stop. The bridge plugged and boulders and debris were scattered along the highway. Cleaning up operations and road repairs from Morton Flat on down the canyon will cost about $6,000.

The city waterline was broken in several places along Coal Creek channel. No water shortages were reported during this interruption but may have occurred and perhaps could have been critical without prompt effort by city crews to repair broken sections. The waterline at the baseball park was also broken.

Water overtopped the baseball park bridge which diverted floodwater into some yards. Thompson Brick and Block Company and other developments situated in the flood path suffered damage. Between 300 and 500 acres of cropland were flooded. The peak flow was estimated at 3,000 cfs and estimated damages were $60,000.

(9/28/1967) Four days of rain resulted in minor flood damages from Coal Creek. The Creek approached capacity but did not overtop its bank.

Dikes broke near the airport permitting floodwater to spread out over the runway causing minor damage. The taxi strip and north-south runway were covered with water. Damages were not known but believed to be less than $1,000. The Indian Village was partially flooded from water running off steep slopes to the east. Some cropland areas were flooded in the valley but no damage estimates were made. 13/

(8/8/1968) - A flood originating in the upper reaches of Coal Creek caused minor damages as floodwater inundated approximately 300 acres. Fifty-six acres of alfalfa and oats were flooded resulting in $900 damages. Estimated damage on 200 acres of cropland will approach $3,000. Estimated damage to irrigation systems and diversions was $500. Road, railroad, bridge, fence repair, and sediment and debris removal will cost about $1,300. These damages total $5,700. The peak flow was estimated at 1,520 cfs. 13/

(7/28/1969) - An intense thunderstorm caused flood damages to land adjacent to Coal Creek and diversion structures within the main channel. Estimated cropland damages were $4,000. Fence damage was estimated at $100. Railroads and bridges and irrigation system damages were reported at $2,000 ($1,000 each). Drainage system damages were $1,500, resulting in a total damage of $7,600. The peak discharge was estimated at 1,100 cfs. 13/

ESCALANTE DESERT SUBBASIN

PINTO CREEK

(7/17/1863) - A series of thundershows caused flooding along Pinto Creek, causing serious property damage. 1/ and 2/

(7/24/1881) - A heavy flood originating in the southeast moved haystacks, grain bins, fences and parts of barns. Some barn sections were completely destroyed. No lives were lost although one home was washed away by rampaging waters. The flood peak was estimated at 3,400 cfs with total damages of $19,400. 1/ 2/ and 12/

(8/19/1901) - There was a succession of heavy rains causing floods during the month. Crops, roads, and ditches received a large amount of damage. Peak discharge from this flood was estimated at 1,000 cfs. 1/, 2/ and 12/

(8/2/1908) - An intense one-hour rain and hailstorm resulted in 1.40 inches of precipitation. Considerable thunder and lightning accompanied the storm that was followed by flooding. Considerable damage to diversion dams and other developments along the creek was expected. 1/ and 2/

SHOAL CREEK

(3/ /1938) - An unusually wet snow fell on a snow pack followed by suddenly warm weather. These conditions caused extensive flooding. Long-time residents report that the runoff was nearly equal to the runoff experienced during 10/27/46. 13/

Several other floods were reported by a farmer living at Enterprise but no details were available as to the magnitude of peak flows or damage. These reported floods included: 4/2/06; 1921, 1952 and 8/8/55.

(10/27/1946) - During October 24 and 25, 1946, a general rain fell throughout the Enterprise area. On October 27, an intense rainstorm began and continued for 51 hours. It extended over an area with radius of approximately 100 miles from Enterprise. The Enterprise Airport reported 2.5 inches of precipitation accumulating during the storm while a resident at Enterprise reported 4.7 inches and a local rancher, Marian Terry, reported 4.75 inches collected in two washtubs which were placed outside his home when the rain started.

Floodwater spread over farm roads, farms and crossed the State Highway from Newcastle to Modena with about .8 foot of water for some 500 feet then tapered off on each side for 500 feet. The flood peak was estimated at 1,028 cfs but an estimate of flood damage was not made. 13/

(12/6/1966) - The Little Grassey SCS rain gage above Enterprise Reservoir recorded 12.6 inches of precipitation between December 1 and December 10. Apparently it all came during December 3 through December 6. Reservoir storage increased by about 4,000 acre feet with an estimated increase of 1,500 acre feet and 2,500 acre feet in the Lower and Upper Enterprise Reservoirs, respectively. Twenty acres of alfalfa land was inundated resulting in $200 damage. Damage to fences, roads, and canal systems amounted to $1,500, $2,000 and $1,000, respectively. In addition, two ponds were filled with sediment and sustained losses of $40,00 resulting in a total loss of $44,700. This flood peak was estimated at approximately 320 cfs. 13/

(1/25/69 to 3/31/1969) - Major floods occurred near Enterprise in three periods: January 25-27, February 25-28, and March 31 through April 14. Damages were estimated at $86,400 for the three floods. Several cross sections were made along Shoal Creek and peak flow estimates computed for the March 31 through April 14 flood. The peak near Enterprise was 875 cfs. The two earlier floods likely peaked at 500 and 700 cfs, respectively.13/

TABLE 1.--Summary of reported floods, Beaver River Basin

Drainage	Date of flood	Peak discharge	Damages	Data source
		C.F.S.	Dollars	a/
Tintic Wash	7-14-1896	1,000	68,050	A
"	7-28-1896	-	-	D
"	2-19-1901	-	-	D
"	8-25-1903	-	-	D
"	8-18-1904	360	1,560	A
"	8-11-1906	340	310	A
"	8-31-1909	320	-	A
"	7-22-1910	-	-	D
"	7-31-1912	600	23,780	A
"	8-26-1912	300	-	A
"	8-07-1915	-	-	D
"	8-05-1916	-	-	D
"	7-23-1918	-	-	D
"	9-01-1919	450	7,540	A
"	9-27-1919	-	-	D
"	5-25-1921	-	-	D
"	7-15-1921	-	-	D
"	7-23-1921	-	-	D
"	8-29-1921	-	-	D
"	8-20-1925	-	-	D
"	7-10-1926	-	-	D
"	7-04-1927	-	-	D
"	9-02-1929	420	5,320	A
"	8-12-1930	-	-	D
"	7-29-1931	-	-	D
"	7-30-1931	700	34,850	A
"	8-14-1931	-	-	D
"	7-09-1933	-	-	D
"	8-15-1934	-	-	D
"	7-23-1936	400	4,070	A
"	8-02-1936	-	-	D
"	7-09-1937	-	-	D
"	8-30-1938	-	-	D
"	9-01-1938	500	12,700	A
Chalk Creek	1885	-	-	D
"	8-25-1886	1,800	1,780	A
"	7-10-1887	-	-	D
"	1888	-	-	D
"	7-13-1896	3,100	18,910	A
"	7-16-1896	2,700	13,000	A
"	8-14-1896	-	-	D
"	7-11-1898	1,700	650	A
"	8-04-1899	1,600	580	A
"	8-07-1901	1,500	510	A

TABLE 1 continued

Drainage	Date of flood	Peak discharge	Damages	Data source
		C.F.S.	Dollars	a/
Chalk Creek cont'd	8-24-1913	1,400	440	A
"	7-27-1917	2,200	6,470	A
"	8-25-1922	-	-	D
"	8-02-1930	1,900	2,910	A
"	8-23-1933	2,100	5,250	A
"	1935	1,400	440	A
"	7-24-1936	-	-	D
"	7-31-1936	2,400	8,980	A
"	1937	1,300	360	A
"	8-02-1943	910	140	A
"	8-05-1955	600	-	B
"	6-03-1957	-	-	D
"	7-31-1959	-	-	D
"	7-31-1961	750	-	B
"	8-07-1963	-	-	D
Meadow Creek	7-14-1896	1,200	4,010	A
"	8-04-1916	1,000	3,180	A
"	7-21-1934	800	2,350	A
"	1938	670	1,800	A
"	1940	750	2,130	A
Corn Creek	7-13-1896	1,650	6,900	A
"	7-16-1896	1,400	5,320	A
"	8-25-1905	1,000	2,770	A
"	8-04-1906	900	2,130	A
"	8-04-1916	-	-	D
"	8-19-1934	900	2,130	A
"	8-15-1936	1,200	4,040	A
"	1938	500	220	A
"	1940	750	1,180	A
"	7-16-1965	1,350	-	B
Wide Mouth Canyon	8-11-1961	75	-	B
"	8-19-1963	2,000	-	B
"	8-17-1965	1,800	-	B
Beaver River	8-04-1873	-	-	D
"	8-15-1901	1,950	39,840	A
"	9-02-1935	-	-	D
"	7-22-1936	1,080	15,600	A
"	8-16-1936	-	-	D
"	9-12-1936	550	830	A
"	9-04-1937	-	-	D
"	9-06-1938	670	4,180	A
"	7-19-1941	195	-	A
"	8-24-1942	190	-	A
"	8-11-1943	230	-	A

TABLE 1 continued

Drainage	Date of flood	Peak discharge	Damages	Data source
		C.F.S.	Dollars	a/
Big Wash @ Milford	7-26-1916	-	-	D
"	8-04-1929	-	-	D
"	7-04-1934	-	-	D
"	7-09-1936	-	-	D
Paragonah	8-06-1901	-	-	D
"	8-14-1901	-	-	D
Center Creek	8-31-1857	-	-	D
"	7-20-1874	-	-	D
"	7-27-1906	-	-	D
"	7-10-1914	-	-	D
"	8-17-1943	143	-	C
"	5-30-1944	115	-	C
"	8-05-1945	386	-	C
"	10-11-1946	115	-	C
"	5-04-1947	136	-	C
"	5-15-1948	194	-	C
"	7-02-1949	114	-	C
"	8-02-1960	1,600	-	C
"	7-13-1967	624	-	B
"	7-22-1968	350	-	B
Summit	7-20-1874	-	-	D
Coal Creek	9-03-1853	-	-	D
"	7-25-1870	-	-	D
"	8-19-1886	1,800	-	A
"	8-10-1901	1,500	-	A
"	7-22-1904	2,450	33,620	A
"	8-12-1907	-	-	D
"	8-21-1907	3,650	134,220	A
"	8-30-1909	-	-	D
"	9-29-1909	-	-	D
"	7-25-1915	3,200	90,130	A
"	1917	2,700	47,430	A
"	8-02-1920	1,190	360	A
"	8-20-1921	4,000	168,810	A
"	7-22-1921	4,500	217,990	A
"	1928	1,650	5,010	A
"	8-13-1930	-	-	D
"	7-30-1931	850	200	A
"	1934	2,300	25,330	A
"	1935	1,450	880	A
"	1935	820	190	A
"	7-09-1936	2,910	61,610	A
"	7-11-1936	1,700	6,030	A
"	8-30-1938	1,500	1,920	A

TABLE 1 continued

Drainage	Date of flood	Peak discharge	Damages	Data source
		C.F.S.	Dollars	a/
Coal Creek cont'd	1939	1,210	370	A
"	1939	1,820	8,510	A
"	1940	1,040	290	A
"	1940	1,610	4,180	A
"	1943	1,250	390	A
"	1945	835	200	A
"	7-14-1953	2,000	-	B
"	7-26-1956	-	-	D
"	8-02-1956	-	-	D
"	8-02-1959	1,200	7,800	B
"	8-03-1959	900	-	B
"	9-17-1961	300	750	B
"	9-08-1961	225	1,800	B
"	8-13-1964	830	9,000	B
"	8-17-1965	1,530	25,080	B
"	7-16-1967	3,000	60,000	B
"	9-28-1967	-	1,000	D
"	8-08-1968	1,520	5,700	B
"	7-28-1969	1,100	7,600	B
Pinto Creek	7-17-1863	-	-	D
"	7-24-1881	3,400	19,400	A
"	1896	2,750	14,140	A
"	8-19-1901	1,000	-	A
"	8-02-1908	-	-	D
"	1929	2,400	11,320	A
"	1930	2,100	8,890	A
"	1936	1,900	7,270	A
"	1937	1,800	6,460	A
"	1938	1,600	4,840	A
"	1939	1,400	3,240	A
"	1940	1,100	810	A
"	1941	950	-	A
"	1942	900	-	A
"	1943	850	-	A
"	8-23-1961	300	-	B
"	8-13-1964	1,080	-	B
"	12-06-1966	1,320	-	B
Shoal Creek	4-02-1906	-	-	D
"	1921	-	-	D
"	3- -1938	-	-	D
"	10-27-1946	1,028	-	D
"	1952	-	-	D
"	8-08-1955	-	-	D
"	12-06-1966	319	44,000	B
"	1-25-1969	500	21,000	B
"	2-26-1969	700	30,000	B
"	3-31-1969	875	38,000	B

TABLE 1 continued

[a]Source of data:

A - Sevier Lake Watershed Report, Appendix Number 4, Watershed Appraisal, U. S. Department of Agriculture, 1950.

B - Utah Standard Flood Report, Soil Conservation Service, U. S. Department of Agriculture.

C - Surface Water Supply of the Colorado River Basin, U. S. Geological Survey.

D - Taken from newspaper accounts.

R E F E R E N C E S

1) Cloudburst Floods in Utah 1950-1938, USGS Water Supply Paper 994.

2) Deseret News, Salt Lake City, Utah

3) Eureka Reporter, Eureka, Utah

4) Government memo, Robert V. Boyle from Charles L. Corry and Leland H. Carlson, 7/20/1953.

5) Iron County Record, Cedar City, Utah

6) Letters describing Coal Creek flood damages on August 2, 3, and 19, from Leland H. Carlson, WUC, at Cedar City, to Thomas B. Evans, AC, Area IV, August 11, and 21, 1959.

7) Ogden Dail Herald, Ogden, Utah.

8) Progress Review, Fillmore, Utah.

9) Reported Chalk Creek Floods by Willard Hansen to Victor Stoles, Forest Service Ranger stationed at Fillmore.

10) Salt Lake Daily Herald, Salt Lake City, Utah.

11) Salt Lake Tribune, Salt Lake City, Utah.

12) Sevier Lake Watershed Report, Appendix No. 4 - Watershed Appraisal, U. S. Department of Agriculture, 1950.

13) Utah Standard Flood Report, Soil Conservation Service, U. S. Department of Agriculture.

14) Weather Bureau annual report.

15) National Engineering Handbook, Chapter 18, Section 4, Hydrology, Soil Conservation Service.